SIGNIFICANT NATURAL FEATURES OF THE EASTERN BOREAL FOREST REGION OF ALBERTA

Prepared for
Alberta Forestry, Lands and Wildlife

Technical Report

Prepared by

D.A. Westworth & Associates Ltd.
Edmonton, Alberta

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EXECUTIVE SUMMARY

On behalf of Alberta Forestry, Lands and Wildlife, a study was undertaken during 1990 by a consulting team headed by D.A. Westworth & Associates Ltd. to identify significant natural features within the Eastern Boreal Forest Region of Alberta. This study represents an initial attempt to identify and classify important natural features and landscapes within a 74 162 km^2 area proposed for future large-scale forestry development.

The study team, comprised of terrain scientists, vegetation ecologists, fisheries biologists and wildlife biologists, spent six months compiling and evaluating existing information on the area, conducting interviews, and carrying out reconnaissance level field surveys, to identify sites that met the various criteria established for the identification of significant natural features. The study was carried out under the guidance and review of a technical steering committee consisting of representatives of the Alberta Forest Service, Fish and Wildlife Division, Public Lands Division (Natural and Protected Areas Program), Land Information Services Division and Energy, Mineral Resources Division.

Objectives of the study were to classify the sites on the basis of their regional, provincial, national or international significance, to evaluate the relative sensitivity of the sites to major types of land use activities, and to identify issues and concerns that are important with respect to protection and management of significant natural features. The adequacy of the existing information base was also assessed and priorities were identified for filling major data gaps.

The Eastern Boreal Forest Region Study Area

The area that is now being referred to as the Eastern Boreal Forest Region of Alberta comprises a 74 162 km^2 area extending across the east side of the province from a point that parallels the towns of Athabasca and Lac la Biche in the south, to a point about 100 km north of Fort McMurray. In addition to the City of Fort McMurray, the study region encompasses a number of smaller centres, 10 Indian Reserves and one Metis Settlement.

The study area consists predominantly of forested crown lands. It lies mainly within the Boreal Mixedwood Ecoregion, but includes portions of the Boreal Northlands and Boreal Foothills Ecoregions. Forests dominated by aspen, balsam poplar, white spruce or pine are interspersed with a diversity of wetlands, peatlands, lakes and streams. It has been estimated that peatlands cover approximately 60% of the area. Most of the region lies within the Athabasca drainage basin, although portions of the area are within the Peace River or Hudson Bay drainages.

Principal land uses in the region include oil and gas extraction, timber harvesting, hunting, fishing, trapping and other forms of recreational use. Two provincial parks (Gregoire Lake and Calling Lake) are located in the study area and a third provincial park has been proposed for the Lakeland area.

EVALUATION OF SIGNIFICANT NATURAL FEATURES

Classification Criteria

Potential sites or areas within the Eastern Boreal Forest Region study area were evaluated for their environmental significance using eight criteria:

- perform a vital environmental, ecological or hydrological function,
- contain rare or unique geological or physiographic features,
- contain significant, rare or endangered plant or animal species
- are unique habitats with limited representation in the region, such as old-growth forests or are a small remnant of once large habitats which have virtually disappeared,
- contain an unusual diversity of plant and/or animal communities due to a variety of geomorphological features and microclimatic effects,
- contain large and relatively undisturbed habitats and provide sheltered habitats for species which are intolerant of human disturbance,
- provide an important linking function and permit the movement of wildlife over considerable distances, including migration corridors and migratory stopover points,

- contain plants, animals or landforms which are unusual or are of regional, provincial, national or international significance

Levels of Significance

The following categories were used to assess the environmental significance of each site:

- **Regional Significance:** Natural landscapes or features that are of limited distribution or the best examples of a feature in the region.
- **Provincial Significance:** Natural landscapes or features which are of limited distribution at a provincial level or are the best examples of a feature in Alberta.
- **National Significance:** Natural landscapes or features that are of limited distribution or are the best examples of a feature in Canada.
- **International Significance:** Natural landscapes or features that are unique in the world.

Based on the classification criteria and levels of significance used in the study, 234 significant natural sites were identified in the 74 162 km^2 study area. Of these sites, three were classified as nationally significant, 44 as provincially significant and 187 as regionally significant.

Terrain Features

Terrain is a general term that refers to the physical characteristics of a landscape. Terrain features contribute to landscape diversity and the scenic value of an area, and often serve important hydrological or ecological functions.

Rivers, streams and lakes comprised the largest group of significant natural features identified during the study, together accounting for 204 (87%) of the 234 sites identified. These include the Athabasca River, which was rated as a nationally significant watercourse, and the Clearwater, Wabasca, Christina, Ells, and Firebag Rivers, which are provincially significant.

A number of sites were identified that represented rare or unique landforms or geological features. These included 14 sites exhibiting glacial features, 8 sites with fluvial features, 3 sites containing eolian landforms, 7 sites containing significant bedrock outcrops or geological sections, 2 sites with karst features, 9 significant peatlands, and 6 sites containing major springs and seeps.

Some of these sites support rare or unusual vegetation communities and provide important wildlife habitat features. Some are also sensitive to various types of surface disturbance. Sand dunes are particularly vulnerable to erosion if the vegetation cover is removed. Patterned peatlands, plateau peatlands and palsas are associated with areas of discontinuous permafrost, and are sensitive to meltout and subsidence if the surface is disturbed. Many of the large peatlands and seepage areas serve important hydrological functions, in stabilizing stream flows and maintaining water quality in streams and lakes, and are therefore sensitive to disturbances affecting the hydrologic regime.

Vegetation Features

The region contains a number of sites of botanical significance, including sites that contain rare or unique vegetation species or communities, areas of unusual vegetation diversity, and areas supporting old-growth forests. Identification of sites containing rare, threatened or endangered species is extremely incomplete at the present time, because of the limited amount of collecting that has been conducted in the region and our poor understanding of the distribution of disjunct species.

Our knowledge of the occurrence of old-growth sites is similarly incomplete. Twelve significant old-growth coniferous stands were identified from a review of the Phase 3 forest inventory data base and an additional 2 old-growth deciduous stands were identified by other researchers. Additional areas and concentrations of potential old-growth stands were identified that require further evaluation. Old-growth stands continue to be lost through timber harvesting, fire and blowdown. Management requirements include the identification of remaining old-growth stands, determining buffer requirements, and conservation of some intermediate-age (80-120 years) stands in proximity to existing old-growth areas.

Wildlife Resources

The Eastern Boreal Forest Region supports a large diversity of wildlife species, including at least 236 species of birds and 43 species of mammals. Wildlife continues to play an important role in the economy of the region, with hunting and trapping constituting important land uses. The region also provides habitat for a number of rare or sensitive wildlife species, including the threatened woodland caribou, the white pelican, double-crested cormorants, ospreys and bald eagles.

Breeding densities of waterfowl in the boreal forest region are typically much lower than those in the prairie pothole region; however, the importance of the many lakes and wetlands in the region increases during periods of drought when the availability of suitable breeding habitat decreases in the prairie-parkland region. The Eastern Boreal Forest Region is also strategically located along two of the major North American flyways, and provides a number of important staging and stop-over locations for waterfowl nesting on the Peace-Athabasca Delta and other northern breeding grounds. Thirty-six waterbodies were identified in the study region that contain significant breeding, moulting or staging habitats for waterfowl.

Twenty-six sites were identified that provide significant habitat for colonial nesting and sensitive bird species. These include four sites (Pelican Lake, Namur Lake, Big Island Lake and Birch Lake) that contain nesting colonies of the white pelican, a species still considered to be endangered in Alberta. The area also contains four colonies of double-crested cormorants and six colonies of great blue herons, with the largest colonies of both species occurring on Pelican Lake. All colonial nesting bird species are considered sensitive to human activity and disturbance of the nesting area.

The ungulate species of greatest concern in the Eastern Boreal Forest Region is the woodland caribou. Caribou populations have declined steadily in the province since the mid-1950s and the species is presently listed as threatened. Ten significant habitat areas for woodland caribou were identified in the study region, although precise information on the abundance and distribution of caribou in the region is lacking. Woodland caribou are more vulnerable than most species to hunting and wolf predation, and are considered sensitive to land use activities that result in loss of winter habitat or increased access.

Moose is the most important species in the region in economic terms and in terms of its subsistence value. Twenty-three significant habitat areas were identified in the study region. These include the Athabasca, Clearwater, Wabasca, Christina, McKay and other major river valleys which provide critical moose wintering areas, and a number of upland areas that provide exceptionally good year around habitat. High quality moose habitat has a limited occurrence in the study region and requires careful management to prevent a general population decline. Control of access to prevent over-exploitation of moose in key habitat areas is the principal management issue at the present time.

Fur trapping remains an important land use activity throughout the study region. Although 17 species of furbearing mammals have been recorded in the region, 4 species, the lynx, river otter, marten and wolverine, are considered particularly vulnerable because of their status and sensitivity to human disturbance. Thirteen of the significant natural sites identified in the present study provide important habitat for one or more of these four species.

Aquatic Resources

The abundance of rivers, streams and lakes in the region support an important commercial, domestic, and recreational sport fishery. Almost one-third of the lakes that are commercially harvested in Alberta occur within the study region.

Three of Alberta's principal drainages, the Peace, the Athabasca, and the Hudson Bay drainage are represented in the study region, although the majority of the area is drained by the Athabasca River. Important fish species include lake trout, walleye, lake whitefish, arctic grayling, cisco, northern pike, yellow perch, goldeye and burbot.

Seventy two lakes and 40 watercourses and watercourse reaches were identified as significant. These areas were chosen to reflect: 1) the economic importance of the northeastern Alberta fishery; 2) declining fish stocks of some of Alberta's most important fish species; 3) outstanding examples of sport and commercial fish production, and; 4) ecologically important habitats or habitats containing rare or unique species. Three significant watersheds (Peerless, Winefred, Namur) were also identified because of a concentration of lakes and streams that meet some or all of the above criteria within a single hydrological unit.

Fish habitats serving a variety of life history functions for valuable or unique fish species, and fish habitats that contained moderate sport or commercial fisheries potential were judged to be regionally significant. Outstanding examples of either of the above two considerations were judged to be provincially significant. Significant watershed areas were also provincially significant because they include both provincially significant waterbodies and regionally significant features. The Athabasca River was judged to be nationally significant because of its size and importance to the area as well as to the Lake Athabasca fishery and the Northwest Territories.

Diversity Features

A number of areas within the study region contain an unusually high diversity of landforms, plant communities, or wildlife habitats. These areas make a significant contribution to the overall biological diversity of the region. A total of 24 diversity areas were identified, ranging in size from 60 to 1000 km^2. Five of these, the Birch Mountains, Crow Lake, Lakeland, Shultz's Bog, and Trout River Delta Diversity Areas, are considered significant in a provincial context. Preservation of areas of high biological diversity is considered important not only for maintaining the genetic diversity of plant and animal communities in the region, but for helping to maintain viable populations of species that have consumptive, non-consumptive and cultural value to the people of the region. Many of these sites also have exceptional recreational, interpretive or educational potential.

Management of Significant Natural Features

The authors of the report express concern that the pace of development is escalating rapidly in the region, without the benefit of an information base adequate for making environmentally sound planning decisions. There is an urgent need for detailed information on the distribution of rare plant and animal species, the distribution of old-growth forests, locations of seasonally important habitats for fish and wildlife populations, and the hydrological importance of the large peatlands in the area. Fisheries and wildlife population surveys conducted by the Fish and Wildlife Division cover less than 15% of the study region, and much of this information may no longer be current. Systematic surveys of woodland caribou have never been conducted in the Eastern Boreal Forest Region.

There is also a need to develop an overall conservation or environmental management strategy for ensuring long-term protection of the area's significant features. A policy for management of significant natural sites could be recognized in conjunction with the forthcoming Alberta Conservation Strategy. Such a policy should outline goals and priorities for conservation and management of significant natural sites.

In addition to developing an overall strategy for managing significant natural sites, there is a need to develop site-specific conservation plans, particularly in areas where development is imminent. Some of the requirements to be considered in developing these plans include:

- The need for an inventory. A detailed biophysical inventory is required to provide information necessary for developing management guidelines, delineating or refining boundaries of significant natural features, and establishing an environmental benchmark;
- The need to identify incompatible land uses;
- The need to determine buffer requirements;
- The need to identify specific management requirements for maintaining viable populations of species identified as rare, threatened or endangered;
- The need to consider all stakeholders. Planning for significant natural features should be viewed as an integrated process that derives input from government, private organizations, native

groups and conservation organizations.

All of the significant natural features identified in the Eastern Boreal Forest Region require some level of protection. The type and degree of protection required may vary all the way from strict legal preservation to simply applying operating restrictions. Alberta has an existing legislative framework for protecting natural ecosystems, that includes designation as provincial parks, wilderness parks, wilderness areas, natural areas or ecological reserves. This may provide a suitable mechanism for protecting certain significant natural features. Some of the significant natural features identified serve as good representatives of significant boreal ecosystems and therefore are appropriate for consideration as natural areas or ecological reserves. The Birch Mountains, because of their diversity, uniqueness, importance for certain species of plants and animals, and relatively pristine condition, merit consideration as a wilderness area or wilderness park. Several of the rivers in the region, including the rapids reach of the Athabasca River, the upper Clearwater River, the lower Christina River, the canyon section of the Wabasca River and the Ells River all warrant protection as some form of wilderness rivers.

Some of the significant natural features identified do not warrant legislative protection, but do require protection in the form of zoning or development restrictions to maintain their inherent environmental values. There is a need to develop some new and innovative strategies for protecting certain types of significant natural features. Key moose and caribou areas, scenic rivers, and sensitive watersheds are examples of features that are vulnerable to significant impact under current management and operating procedures. There is an urgent need to find workable solutions to the problem of over-exploitation of fish and wildlife populations as a result of increased access into remote areas.

STUDY TEAM

D.A. Westworth & Associates Ltd.
Lawrence Brusnyk (Project Manager)
David Westworth
Doug Skinner
David Halstead
Richard Chabaylo
Aldine Peters

Pedocan Land Evaluation Ltd.
Leonard Knapik

Peter Achuff

TECHNICAL STEERING COMMITTEE

Alberta Forestry, Lands and Wildlife

Land Information Services Division
Marilyn Rayner (Chairperson)
Jerry Bentz

Public Lands Division
Peter Lee

Alberta Forest Service
Susan Gillespie

Fish and Wildlife Division
Hugh Wollis

Alberta Energy
Mineral Resources Division
Mary Penny

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1.0 INTRODUCTION

Interest in setting aside or protecting significant natural features or landscapes has increased in Canada as both the public and government agencies become increasingly aware of the consequences of expanding human settlement and natural resource development. As a result, various levels of government have become involved over the last 20 years in efforts to conserve or protect important natural landscapes. For example, the federal government has participated through the national parks program while Alberta and other provinces have enacted legislation to establish provincial parks, wilderness areas, natural areas and ecological reserves.

Conservation efforts have increased on a regional level as well. In Canada, the most important work in the development of criteria for identifying significant natural features and landscapes occurred as a result of studies undertaken for various regional governments in southern Ontario by the Centre for Resources Development at the University of Guelph during the 1970s (Eagles et al. 1976, Elrick et al. 1977, Blackman et al. 1978). The criteria developed during these studies and subsequently updated by Eagles (1980, 1984) deal principally with the identification of areas that represent unique, unusual or remnant ecosystems, unique landforms, habitat for rare and endangered species, areas of unusually high biological diversity, areas that perform a vital ecological function and areas with significant scientific or educational potential. These studies formed the basis for criteria that were subsequently used in environmentally significant areas studies undertaken in the Calgary (Lamoureux et al. 1983), Oldman (Cottonwood Consultants 1987, 1988, 1989), Paintearth (Sweetgrass Consultants 1989), Sturgeon (Infotech 1989a, 1989b), Strathcona (Westworth and Knapik 1987) and Leduc (Brusnyk et al. 1990) regions of Alberta.

In heavily settled or developed regions, natural landscapes have been dramatically reduced in area and in some regions, important natural landscapes have disappeared entirely. These concerns are perhaps most acute in the vicinity of major urban centres where expanding residential and industrial developments threaten significant natural features or in the prairie or parkland regions of Alberta, where agricultural intensification has resulted in the conversion of native habitat to agricultural lands.

Unlike southern areas of Alberta, the eastern boreal forest region has, until recently, remained relatively undeveloped. With the exception of several oilsands developments in the Fort McMurray and Wabasca regions, most of the activity in this region has been related to oil and gas exploration, trapping, hunting and fishing. However, recent announcements concerning an additional oilsands plant in the Fort McMurray area and large-scale forestry development in the boreal forest could have important long-term implications for natural resources in the region.

This report presents the results of a study initiated by Alberta Forestry, Lands and Wildlife to identify significant natural features within the Eastern Boreal Forest Region of Alberta. The study represents an initial attempt to document the significant biophysical features of the region and to outline strategies for their conservation and management. The study was conducted over a six month period by a consultant team headed by D.A. Westworth & Associates Ltd., which included terrain scientists, vegetation ecologists, aquatic biologists and wildlife biologists. The study was conducted under the direction of a technical steering committee comprised of representatives of the Alberta Forest Service, Fish and Wildlife Division, Public Lands Division, and Land Information Services Division of Alberta Forestry Lands and Wildlife and the Mineral Resources Division of Alberta Energy.

1.1 Objectives

The overall objective of the study was to conduct a reconnaissance level inventory of significant natural features in the Eastern Boreal Forest Region of Alberta. Specific objectives of the study were to:

- Provide an inventory of significant natural features of regional, provincial, national or international importance.
- Evaluate the relative sensitivity of sites classed as significant.

- Identify management considerations for significant natural features.
- Identify information gaps and required research.

1.2 Report Organization

The results of the present study are presented in two parts. The first part of the report is comprised of the Technical Report which contains introductory and explanatory information on the approach used in the study, classification and description of significant natural features, and a discussion of management requirements. Significant natural features identified during the study are presented on a series of 1:500,000 scale maps. The second part of the report provides a complete listing of the database files developed during the study. A database file using dBase III+ was created that included key features of each significant natural feature such as geographic location (section, township and range), type of significant natural feature, significance level, and a brief description of other key or important features.

2.0 LOCATION OF STUDY AREA

The Eastern Boreal Forest Region study area occupies an area of approximately 74 162 km^2, extending along the east side of the province from a point that roughly parallels the towns of Athabasca and Lac La Biche in the south to a point approximately 100 km north of Fort McMurray (Figure 1). The study area contains portions of three major drainage basins including the Peace River, Athabasca River and Beaver River drainages. The Athabasca, Clearwater and Wabasca Rivers are the major watercourses in the study area while Peerless, North and South Wabasca, Gordon and Winefred Lakes comprise the largest lakes.

The study area is bisected in a north-south direction by Highway 63 along which the City of Ft. McMurray (33,698 people) is located (Alberta Municipal Affairs 1989). A number of smaller centres, 10 Indian Reserves and one Metis Settlement are also present in the area.

Much of the Eastern Boreal Forest study area is comprised of crown lands. Principal land uses in the area include fishing, hunting, trapping, and other forms of recreation as well as oil and gas extraction and some timber harvesting. Agricultural activities tend to be restricted to the southern fringe of the study area. Two provincial parks (Gregoire Lake and Calling Lake), one ecological reserve (Crow Lake Ecological Reserve) and 5 natural areas (La Saline, Clearwater Springs, Whitemud Falls, Hondo and Saulteaux River Natural Areas) are located in the study area. One additional provincial park (Lakeland Provincial Park and Recreation Area) and several candidate natural areas are proposed for the area.

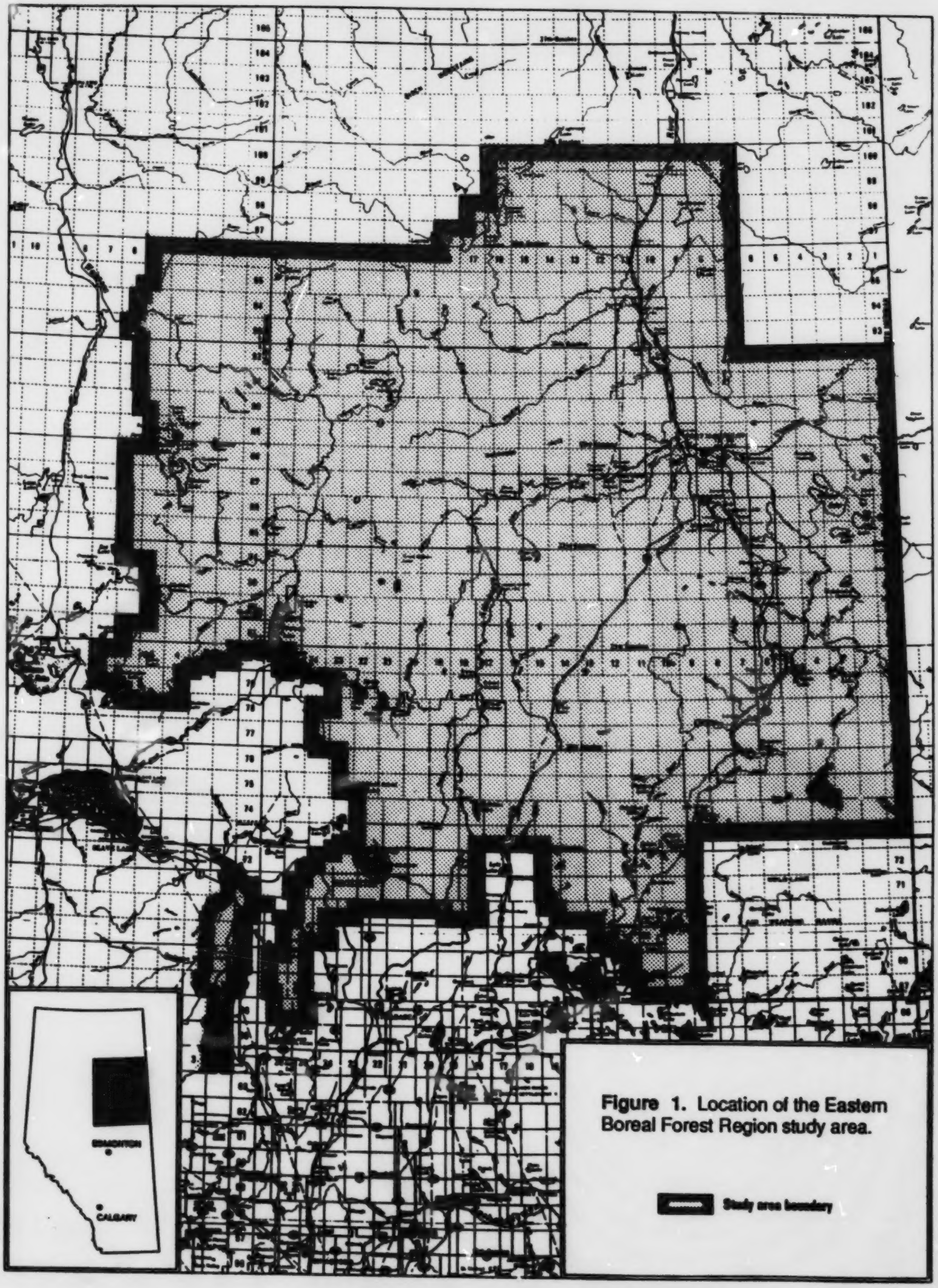

EDMONTON
CALGARY
Study area boundary

Figure 1. Location of the Eastern Boreal Forest Region study area.

3.0 EVALUATION OF SIGNIFICANT NATURAL FEATURES

3.1 Classification Criteria

Potential sites or areas within the Eastern Boreal Forest Region study area were evaluated for their environmental significance using eight criteria or components of the natural environment identified by Eagles (1984). This included those areas that:

- perform a vital environmental, ecological or hydrological function,
- contain rare or unique geological or physiographic features,
- contain significant, rare or endangered plant or animal species
- are unique habitats with limited representation in the region, such as old-growth forests or are a small remnant of once large habitats which have virtually disappeared,
- contain an unusual diversity of plant and/or animal communities due to a variety of geomorphological features and microclimatic effects,
- contain large and relatively undisturbed habitats and provide sheltered habitats for species which are intolerant of human disturbance,
- provide an important linking function and permit the movement of wildlife over considerable distances, including migration corridors and migratory stopover points,
- contain plants, animals or landforms which are unusual or are of regional, provincial, national or international significance

These environmental components or criteria are consistent with those used in environmentally significant areas studies conducted in the settled areas of the province as well as with current concepts in environmental planning used in developing environmentally significant areas criteria and classification methodologies.

3.2 Levels of Significance

The environmental significance of each site was assessed with respect to the following categories (Eagles 1984):

- **Regional Significance:** Natural landscapes or features that are of limited distribution or the best examples of a feature in the region.
- **Provincial Significance:** Natural landscapes or features which are of limited distribution at a provincial level or are the best examples of a feature in Alberta.
- **National Significance:** Natural landscapes or features that are of limited distribution or are the best examples of a feature in Canada.
- **International Significance:** Natural landscapes or features that are unique in the world.

To assess the regional significance of a site, boundaries were defined which subdivided the eastern boreal forest study area into three regions (Figure 2). The regions were defined on the basis of three forest management units used by the Alberta Forest Service and included the Slave Lake, Lac La Biche and Athabasca forests. Examples of regionally significant features include:

- hydrologically significant rivers, streams and lakes
- habitats which support populations of plants or animals that are rare in the region
- areas of unusually high landform, vegetation and wildlife diversity
- lakes supporting important commercial, domestic or sport fisheries
- rivers and streams supporting spawning populations of important sportfish species such as arctic grayling or walleye
- important wintering areas for moose
- important wildlife movement corridors
- key habitat areas for sensitive furbearing species such as otter, marten, lynx and wolverine

Examples of provincially significant features include:

- hydrologically important rivers
- lakes supporting viable populations of lake trout
- lakes contributing a significant proportion of the provincial commercial or domestic catch of whitefish and cisco
- nesting colonies of white pelicans
- provincially significant waterfowl staging and production areas

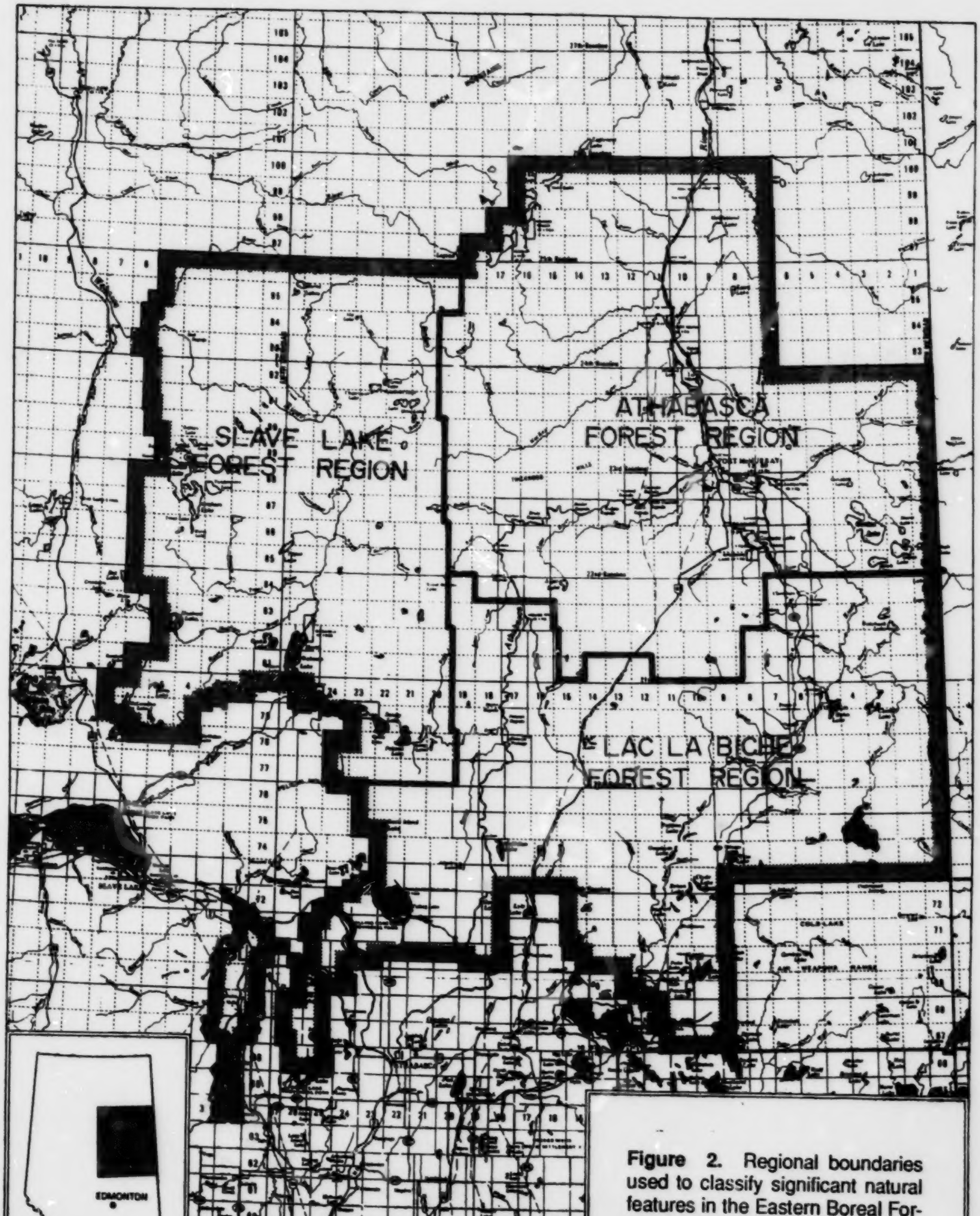

SLAVE LAKE
FOREST REGION
ATHABASCA
FOREST REGION
LAC LA BICHE
FOREST REGION
SLAVE LAKE
COLD LAKE
EDMONTON
CALGARY

Figure 2. Regional boundaries used to classify significant natural features in the Eastern Boreal Forest Region.

Forest Region

- habitats which support populations of plants or animals (eg. woodland caribou) that are rare in Alberta
- areas of unusually high landform, vegetation and wildlife diversity

Examples of nationally significant features include:

- inter-provincially important watercourses
- areas that support plants or animals that are rare in Canada
- areas that contain habitat that contain significant populations of plants or animals that are rare in Canada
- areas that contain vegetation communities or habitats that are rare in Canada

4.0 METHODS

4.1 Literature Review and Interviews

The first phase of data collection involved a comprehensive review of all available published and unpublished reports and maps from government agencies, university libraries and private sector sources. This included major data files maintained by Alberta Ecological Survey, Alberta Fish and Wildlife Division, Alberta Natural and Protected Areas, Alberta Environment (Alberta Oil Sands Environmental Research Program reports), Alberta Research Council, Provincial Museum of Alberta, Alberta Soil Survey and Alberta Forest Service.

In addition to the literature review, as many interviews as possible were conducted with scientists, government personnel and other knowledgable people to obtain any additional information on potential environmentally significant sites. Individuals associated with various government agencies including Alberta Fish and Wildlife Division, Alberta Recreation and Parks, Alberta Forest Service, Alberta Research Council, Forestry Canada, Canadian Wildlife Service and the Provincial Museum of Alberta were contacted. Knowledgable people in the university, naturalist and environmental conservation community were also interviewed.

4.2 Aerial Photograph Interpretation

Airphoto interpretation of the study area was conducted using 1982 to 1985 1:60,000 black and white aerial photographs and 1:500,000 scale Landsat TM images. In conjunction with 1:50,000 NTS maps, major landscape units and vegetation types, and features of potential interest were identified in the study area.

No minimum size criteria were used in identifying sites containing significant natural features in the present study. Instead, significant natural sites were selected on the basis of their environmental significance, ecological function, rarity and/or sensitivity, regardless of size. Some features, such as unique vegetation or terrain features, are not readily identifiable on 1:60,000 aerial photographs while certain wildlife features may be significant because of their size and contiguity with other habitat features.

During airphoto interpretation, the following were identified:

- Areas of vegetation diversity
- Areas of landform diversity
- Major stands of old-growth or climax forest
- Areas with interesting, unique or unusual landscape features (eg. rock outcrops, sand dune formations)
- Areas with important hydrological or hydrogeological functions (eg. major springs, discharge areas)
- Areas that provide excellent examples of geological formations or natural ecosystems and
- Major wetlands and other habitat features.

Unlike some of the environmentally significant areas studies conducted in the province, the scope of the present study did not include the identification and evaluation of hazard lands and areas of cultural and historic (i.e. archaeological, palaeontological and historical sites) significance.

4.3 Field Reconnaissance

Field surveys were conducted to evaluate or confirm the significance of candidate sites identified from the literature review, interviews and airphoto interpretation. Ground inspections were limited due to access and most sites were visited during a series of helicopter surveys conducted in September, 1990. Since the scope of study did not permit detailed sampling, field evaluations were of a general nature, providing the study team with an opportunity to make a professional judgement about the significance of each site. Photographs were taken of each site and information on features such as community type, successional stage, presence of rare plant or wildlife species, travel corridors, mineral springs, general wildlife use and habitat condition were recorded using a micro-cassette recorder.

5.0 OVERVIEW OF NATURAL FEATURES AND LANDSCAPES

5.1 Terrain Features

The general shape of the landscape surface in the Eastern Boreal Forest Region study area may be characterized as a gently undulating plain containing several upland areas and dissected by a number of major river valleys. The upland areas are remnants of pre-glacial plains that did not erode during glaciation. All of the area was glaciated and as a result, glacial drift covers bedrock formations in a layer ranging from less than one metre to hundreds of metres thick. Landforms related directly to glacial action and to meltwater from receding glaciers dominate the landscape. Much of the area was covered by post-glacial lakes, and the deltaic and beach deposits associated with these lakes contribute to the landscape diversity present in the area.

Peatlands, which cover a large portion (approximately 60%) of the study area, have very important hydrologic functions and high habitat values for a variety of wildlife. The study area contains a variety of peatland types and those located in the northern portion of the study area frequently have permafrost-related features.

5.2 Vegetation Features

Ecologically, the study area is dominated by the Boreal Mixedwood Ecoregion, however, portions of the Boreal Northlands and Boreal Foothills Ecoregions are also present (Strong and Leggat 1981). As the largest ecoregion in Alberta (43% of the provincial land base), the Boreal Mixedwood Ecoregion forms the transition zone from the Aspen Parkland in the south to the Boreal Northlands Ecoregion in the north. The study area falls mostly in the Moist Mixedwood Subregion of the Boreal Mixedwood Ecoregion which has an average summer precipitation value of 320 mm. The central portion of the study area falls within the Wet Mixedwood Subregion, which receives an average of 420 mm of precipitation (Strong and Leggat 1981). Mean yearly precipitation values average 440 mm. Aspen and white spruce forests predominate on the well- to moderately well-drained sites while extensive black spruce bogs and larch fens are found in the wetter, depressional sites. Jack pine stands are typically found on drier, rapidly- to moderately well-drained sites throughout the area.

The Pelican Mountains represent the most easterly outlier of the Boreal Foothills Ecoregion in Alberta. This ecoregion typically is found at higher elevations than the Boreal Mixedwood Ecoregion and forms the transition zone between the Boreal Uplands and Boreal Mixedwood Ecoregions. Mean yearly precipitation values average 570 mm. Vegetatively, the moderately well-drained sites are characterized by aspen, balsam poplar, lodgepole pine and white spruce while the wetter sites are dominated by black spruce. Rapidly to well-drained sites are typically vegetated by lodgepole pine and ericaceous shrubs (Strong and Leggat 1981).

The Boreal Northlands Ecoregion is found in the northern portion of the province, however, the Birch Mountains outlier is found within the Eastern Boreal Forest Region study area. Climatically, this ecoregion is cooler and receives less precipitation (340 mm) than the other two ecoregions in the study area. Moderately well-drained mixedwood forests comprised of aspen and white spruce are considered to be the representative vegetation type for this ecoregion. Jack pine forests predominate the rapidly to well-drained sites while black spruce stands are found on wetter, depressional sites (Strong and Leggat 1981).

5.3 Wildlife Resources

The Eastern Boreal Forest Region supports a diversity of wildlife species. These include at least 236 species of birds (Francis and Lumbis 1979) and 43 species of mammals (D.A. Westworth & Associates Ltd. 1979). Historically, wildlife has played an important role in the economic and cultural development of the region. Wildlife are still important in the subsistence economy of the region, and the importance of wildlife as a recreational resource is increasing as hunting and wildlife viewing opportunities become limited in settled areas of the province.

The faunal diversity of the area reflects the high degree of habitat diversity characteristic of the Boreal Mixedwood Ecoregion. Waterfowl continue to constitute the avian group of greatest recreational importance. The boreal forest region is not as important as the prairie pothole region in terms of waterfowl production; however, the wetlands of the boreal forest provide stable breeding habitats that increase in importance during periods of drought on the prairies. The study region is also strategically located with respect to major flyways for migratory birds and receives extensive use by waterfowl migrating to the Peace-Athabasca Delta and other northern breeding grounds. The region also provides breeding habitat for a number of vulnerable or rare species of birds. These include the white pelican, which is considered endangered in Alberta, and double-crested cormorants and great-blue herons, which nest in colonies and are sensitive to disturbance.

Five ungulate species, including the woodland caribou, moose, elk, mule deer, and white-tailed deer, occur in the Eastern Boreal Forest Region. Of these, the moose is the most abundant and widespread, and also has the greatest economic importance in terms of recreation and human subsistence. The status of the woodland caribou in the region is poorly known. Caribou are considered threatened in Alberta, and because of their declining numbers and unique habitat requirements, are the focus of management concern. The remaining ungulate species are sparsely distributed in the region, although numbers of white-tailed deer are thought to be increasing as this species expands its range in northeastern Alberta. At least 16 species of furbearers have been identified in the area (Todd 1978). Beaver are the most common and economically important species, reflecting the number of rivers, streams, lakes and other wetland habitats within the boreal mixedwood region. In Alberta, the river otter achieves its highest densities in the study region. The status of most other species of furbearers and small mammals in the study region is poorly known.

5.4 Aquatic Resources

The abundance of rivers, streams and lakes in the study region supports an important commercial, domestic and recreational sport fishery. Three of Alberta's principal drainages, the Peace, the Athabasca and the Hudson Bay drainage are represented in the study region. Important fish species include lake trout, walleye, lake whitefish, arctic grayling, cisco, northern pike, yellow perch, goldeye, and burbot. In a provincial context, these fisheries are estimated to account for as much as 25 to 50% of all fish taken for domestic use, 20 to 25% of the commercial fish harvest, and 10 to 20% of all sportfish captured. Despite the importance of the fisheries resources of the region, survey data are available for only a relatively small proportion of the lakes and watercourses in the study region.

6.0 INVENTORY OF SIGNIFICANT NATURAL FEATURES

Aerial photo interpretation using black and white aerial photography and Landsat TM imagery resulted in the identification of 614 potential significant natural sites within the 74 162 km^2 Eastern Boreal Forest Region study area. Following an iterative process that involved individual and agency interviews, literature reviews, and field reconnaissance surveys, a final list was compiled that included 234 significant natural sites. Of these sites, 3 were classified as a nationally significant (three reaches of the Athabasca River), 44 as provincially significant and 187 as regionally significant (Table 1). A significant proportion of these sites (87%) are comprised of natural features associated with lakes, wetlands, rivers and creeks.

Relevant information on each of the sites identified is provided in the database file that is appended to the report. The file includes the name and number of the site, land location, mapsheet number, airphoto numbers, significance rating and significant natural features. Although the sites were identified on the basis of criteria presented in Section 3.1, the 234 areas can be broadly grouped into the following five categories:

- Significant Terrain Features (including landforms and hydrological features)
- Significant Vegetation Features
- Significant Wildlife Habitats
- Significant Fish Habitats
- Significant Diversity Areas

Locations of the significant natural sites are indicated on a series of 1:500,000 scale maps appended to the report. Because of differences in functions and values of individual significant natural sites, many have overlapping boundaries. To assist in the identification of individual sites on the maps, information is presented thematically on four map sheets which are appended to the report:

- **Map 1.** Composite Map

Table 1. Summary of significant natural features in the Eastern Boreal Forest Region of Alberta, 1990-91.

Site #	Site Name	Sig. Level	Significant Natural Features			Twp.	Rge.	Mer.	Map #
001	Crow Lake Diversity Area	Provincial	Rare vegetation species	High vegetation diversity	High landform diversity	078	14	4	1, 3
002	Eymundson Sinkholes	Provincial	Significant sinkhole features			098	10	4	1, 3
003	McClelland Lake Fen	Provincial	Signicant patterned fen	Rare vegetation species	Significant plant species	097	09	4	1, 3
004	La Saline Springs Natural Area	Provincial	Significant spring features	Rare vegetation species	Important waterfowl area	093	10	4	1, 3
005	Clearwater Springs	Provincial	Rare vegetation species	Significant spring features		088	05	4	1, 3
006	Whitemud Falls Ecol. Reserve	Regional	Significant hydrologic feature	Significant plant species	Hydrologically important river	089	01	4	1, 3
007	Namur Lake	Provincial	Important sportfishery	Important trophy fishing lake	Important pelican nesting area	097	17	4	1, 2, 4
008	Schultz's Bog Diversity Area	Provincial	Important caribou habitat	Significant palsa bog	High landform diversity	089	18	4	1, 3, 4
009	Gods Lake Diversity Area	Regional	High vegetation diversity	High landform diversity	High wildlife diversity	090	01	5	1, 3
010	Burnt Lakes	Regional	High vegetation diversity	Significant plant community	Important sportfishery	095	25	4	1, 2
011	Owl River Diversity Area	Regional	High vegetation diversity	High landform diversity	Important moose habitat	069	13	4	1, 3, 4
012	Lakeland Diversity Area	Provincial	Hydrologically important lake	Important sportfishery	High landform diversity	067	10	4	1, 2, 3
013	Firebag River Delta	Regional	Excellent example of oxbows	Significant meander feature	High vegetation diversity	100	09	4	1, 4
015	Sand Lake	Regional	Important waterfowl staging area	Important sportfishery	Hydrologically important lake	100	15	4	1, 2, 4
016	Water Lily Lake Slumps	Regional	Significant slump area	High landform diversity	High vegetation diversity	100	16	4	1, 3
017	Gardiner Lakes	Regional	Important sportfishery	Important trophy fishing lake	Important waterfowl staging area	098	16	4	1, 2, 4
018	Ells River	Provincial	Important sportfishery	Excellent example of oxbows	High vegetation diversity	094	15	4	1, 2, 3
019	Horseshoe Lake	Regional	Important waterfowl area	Significant plant species	Hydrologically important lake	093	10	4	1, 2, 4
020	Liege River	Regional	High vegetation diversity	High landform diversity	Hydrologically important river	094	25	4	1, 2
021	Algar Lake Sandhills	Regional	Significant dune/wetland complex	High vegetation diversity	High wildlife diversity	086	17	4	1, 3, 4
022	Boivin Creek Peatland	Provincial	Significant discharge fen	Important caribou habitat	High vegetation diversity	081	17	4	1, 3, 4
023	Long Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl nesting area	089	04	5	1, 2, 4
024	High Hill River Springs	Regional	Significant spring features	Significant plant species	Wildlife mineral lick	089	03	4	1, 3
026	Gordon Lake	Provincial	Important waterfowl area	Hydrologically important lake		086	03	4	1, 2, 4
028	Christina River Peatlands	Regional	Significant patterned bog	Signicant patterned fen	High landform diversity	083	08	4	1, 3
029	Newby River	Regional	Wildlife movement corridor	Significant meander reach	Hydrologically important river	082	03	4	1, 2
030	Peavine Prairie Diversity Area	Regional	High landform diversity	Important moose habitat	High vegetation diversity	071	12	4	1, 3, 4
031	Firebag River	Provincial	Important sportfishery	Important moose habitat	High landform diversity	100	08	4	1, 2, 3, 4
032	Marguerite River	Regional	Important sportfishery	High landform diversity	Important moose habitat	100	07	4	1, 2
033	Christina Crossing	Regional	Old-growth forest			084	03	4	1, 3
034	Muskeg River (North)	Regional	Important sportfishery			095	09	4	1, 2
035	Egg L.-Algar L. Caribou Area	Provincial	Important caribou habitat	Signicant patterned fen	High vegetation diversity	082	12	4	1, 4
036	Kearl Lake	Regional	Important waterfowl staging area	Rare vegetation species	Hydrologically important lake	096	08	4	1, 2, 4
037	Hartley Creek	Regional	Important otter habitat	Important sportfishery	Hydrologically important creek	094	09	4	1, 2
038	Pierre River	Regional	Wildlife movement corridor	Important sportfish area	Important furbearer habitat	098	11	4	1, 2
039	Kearl Lake Moose Area	Regional	Important moose habitat	Wildlife movement corridor	Hydrologically important creek	096	08	4	1, 4
040	Steepbank River	Regional	Important sportfishery	Wildlife movement corridor	Hydrologically important river	091	08	4	1, 2
042	Christina River OGF	Regional	Old-growth forest			087	06	4	1, 3
043	Clarke Creek	Regional	Important sportfish area	Important sportfish area	Hydrologically important creek	090	08	4	1, 2

Table 1. Continued....

Site #	Site Name	Sig. Level	Significant Natural Features			Twp.	Rge.	Mer.	Map #
045	Clearwater River	Provincial	Important sportfishery	Important moose habitat	High landform diversity	089	03	4	1, 2, 3, 4
046	Edwin Creek OGF	Regional	Old-growth forest			089	03	4	1, 3
049	High Hill River	Provincial	Important sportfishery	Wildlife movement corridor	Hydrologically important river	091	03	4	1, 2, 3
052	Gordon River	Regional	Wildlife movement corridor	Hydrologically important river		086	04	4	1, 2
053	Mink-Grew Lakes OGF	Regional	Old-growth forest			091	21	4	1, 3
057	Gipsy Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important bald eagle staging area	086	02	4	1, 2
060	Birch Lake	Provincial	Important pelican nesting area	Hydrologically important lake	Important cormorant nesting area	085	03	4	1, 2, 4
062	Saprae Creek	Regional	Important sportfish area	Important sportfish area	Hydrologically important creek	088	07	4	1, 2
063	Saline Creek	Regional	Important sportfish area	Important sportfish area	Hydrologically important creek	088	08	4	1, 2
064	Gregoire River	Regional	Important sportfishery	Wildlife movement corridor	Hydrologically important river	086	08	4	1, 2
065	Gregoire Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl staging area	086	08	4	1, 2, 4
067	Georges Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	084	05	4	1, 2
069	May River	Regional	Important sportfishery	Wildlife movement corridor	Hydrologically important river	076	10	4	1, 2
071	Kettle River	Regional	Wildlife movement corridor	Important sportfishery		080	05	4	1, 2
077	Kirby Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	075	05	4	1, 2
078	Christina Lake/Jackfish River	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl nesting area	076	06	4	1, 2, 3, 4
079	Wappau Lake	Regional	Important waterfowl nesting area	Important bald eagle habitat		075	11	4	1, 2, 3, 4
080	Base Lake and Creek	Regional	Important sportfishery	Significant outwash channel		077	12	4	1, 2
081	Surmont Creek	Regional	Important sportfish area	Important sportfish area	Hydrologically important creek	085	08	4	1, 2
082	Winefred River	Regional	Important sportfishery	Important otter habitat	High vegetation diversity	081	04	4	1, 2
083	Watchusk Lake	Regional	Important sportfishery	Important furbearer habitat		083	02	4	1, 2
084	Banana Lake	Regional	Old-growth forest	Important osprey nesting area		067	26	4	1, 2, 3, 4
088	Cowper Lake	Regional	Important waterfowl nesting area	Important sportfishery	Hydrologically important lake	080	03	4	1, 2, 4
089	Bohn Lake	Regional	Important waterfowl nesting area	Important sportfish area	Hydrologically important lake	080	05	4	1, 2, 4
090	Winefred Lake	Provincial	Important sportfishery	Important trophy fishing lake	Bald eagle nesting area	075	04	4	1, 2, 4
091	Grist Lake	Provincial	Important sportfishery	Hydrologically important lake		074	04	4	1, 2
093	House River Meltwater Channel	Regional	Important sportfishery	Significant outwash channel	Important moose habitat	077	14	4	1, 2, 3, 4
096	Hangingstone River	Regional	Important sportfishery	Wildlife movement corridor	Hydrologically important river	085	09	4	1, 2
098	Horse River	Regional	Important sportfishery	Important moose habitat	Significant meander reach	089	09	4	1, 2, 4
101	Algar Lake	Regional	Important waterfowl area			084	15	4	1, 2, 4
104	Buffalo Creek Lake	Regional	Important pelican staging area	High vegetation diversity	Important furbearer habitat	087	20	4	1, 2
113	MacKay River	Regional	Important sportfishery	Important moose habitat	Significant meander reach	094	11	4	1, 2, 3, 4
115	Dunkirk River	Regional	Important sportfish area	Hydrologically important river	Wildlife movement corridor	093	20	4	1, 2
118	Dover River	Regional	Important sportfishery	High vegetation diversity	Hydrologically important river	094	12	4	1, 2, 3
120	Namur River	Regional	Important sportfishery	Hydrologically important river		098	16	4	1, 2
124	Pelican OGF	Regional	Old-growth forest			077	22	4	1, 3
125	Pelican Mountains	Regional	Significant plant community	Significant plant species	High wildlife diversity	076	23	4	1, 3
127	Pelican River Diversity Area	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	079	19	4	1, 3
128	Pelican Lake	Provincial	Important pelican nesting area	Important waterfowl area	Hydrologically important lake	078	21	4	1, 2, 4

Table 1. Continued....

Site #	Site Name	Sig. Level	Significant Natural Features			Twp.	Rge.	Mer.	Map #
129	Wabasca River (Upper)	Provincial	Important sportfishery	Important moose habitat	Hydrologically important river	085	24	4	1, 2, 4
132	North Wabasca Lake	Provincial	Important sportfishery	Commercial/domestic fishery		081	26	4	1, 2
133	South Wabasca Lake	Provincial	Important sportfishery	Commercial/domestic fishery	Important waterfowl area	080	25	4	1, 2, 4
135	Sandy Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl area	079	22	4	1, 2, 4
136	Drowned Horse Creek Diversity	Regional	High landform diversity	High vegetation diversity		078	24	4	1, 3
137	Godin Lake	Regional	Hydrologically important lake			082	01	5	1, 2
138	Weaver Lake	Regional	Important waterfowl nesting area	Important sportfish area	Hydrologically important lake	080	01	5	1, 2, 4
139	McLeod Lake	Regional	Important waterfowl nesting area	Important sportfishery	Hydrologically important lake	080	01	5	1, 2, 4
140	Sander Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	080	02	5	1, 2
141	Pastecho River	Regional	Hydrologically important river	Hydrologically important lake	High landform diversity	082	02	5	1, 2
144	McMillan Lake (West)	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	078	04	5	1, 2
145	Unnamed Lake	Regional	Hydrologically important lake	Important heron nesting area	Important cormorant nesting area	086	04	5	1, 2, 4
146	Muskwa Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	082	05	5	1, 2, 4
147	Muskwa River	Regional	Hydrologically important river	High landform diversity	Important moose habitat	082	03	5	1, 2, 4
148	Calling River	Regional	Important sportfishery	High landform diversity	High vegetation diversity	073	23	4	1, 2, 3
149	Calling Lake	Provincial	Important sportfishery	Commercial/domestic fishery	Important waterfowl staging area	072	22	4	1, 2, 4
150	Rock Island Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl area	075	22	4	1, 2, 4
151	Nipisi River Diversity Area	Regional	High wildlife diversity	High vegetation diversity	High landform diversity	080	06	5	1, 3
152	Nipisi Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	078	07	5	1, 2, 4
157	Legend Lake	Regional	Important sportfishery	Hydrologically important lake		097	19	4	1, 2
158	Christina River (Lower)	Provincial	Important sportfishery	Important moose habitat	Important raptor nesting area	087	05	4	1, 2, 4
159	House Creek	Regional	Wildlife movement corridor	Hydrologically important creek	Important sportfishery	091	25	4	1, 2
162	Mink Lake	Regional	Hydrologically important lake	Important pelican staging area	Important pelican feeding area	091	21	4	1, 2
163	Grew Lake	Regional	Important pelican staging area	Important pelican feeding area	Hydrologically important lake	091	20	4	1, 2
165	Chipewyan Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	092	22	4	1, 2
169	Wood Buffalo River	Regional	Hydrologically important river	Hydrologically important lake	Significant meander reach	086	23	4	1, 2
175	Ells Tower OGF	Regional	Old-growth forest			094	15	4	1, 3
176	Utikuma River	Regional	Wildlife movement corridor	Hydrologically important river		083	05	5	1, 2
178	Bat Lake	Regional	Hydrologically important lake			084	06	5	1, 2
180	Trout River Channel	Regional	Significant outwash channel	Significant meander reach	Important furbearer habitat	084	03	5	1, 2, 3
182	Marie Lake	Regional	Important waterfowl nesting area	Hydrologically important lake		086	04	5	1, 2, 4
183	Graham Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important cormorant nesting area	087	04	5	1, 2, 4
184	Peerless Lake	Provincial	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	088	05	5	1, 2, 4
185	Vandersteene Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	088	03	5	1, 2, 4
186	Firebag River OGF	Provincial	Old-growth forest	Significant meander reach		100	09	4	1,3
187	Goodfish Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	089	05	5	1, 2, 4
191	Woodenhouse River	Regional	Hydrologically important river	Significant meander reach	Wildlife movement corridor	087	24	4	1, 2
195	Panny River	Regional	Hydrologically important river	Hydrologically important lake	High landform diversity	095	05	5	1, 2
197	Hunt Creek OGF	Regional	Old-growth forest			093	06	5	1, 3

Table 1. Continued....

Site #	Site Name	Sig. Level	Significant Natural Features			Twp.	Rge.	Mer.	Map #
198	Wandering River	Regional	Important sportfishery	Wildlife movement corridor	Significant meander reach	073	17	4	1, 2
201	Owl River	Regional	Important sportfishery	Hydrologically important river	Significant meander reach	071	11	4	1, 2
202	Logan River	Regional	Important sportfishery	Significant outwash channel		073	12	4	1, 2, 3
203	Goodwin Lake	Regional	Important heron nesting area	Significant outwash channel	Important sportfish area	074	11	4	1, 2, 3, 4
204	Clyde River	Regional	Wildlife movement corridor	Important sportfish area	Hydrologically important river	071	12	4	1, 2
205	Clyde Lake	Regional	Important waterfowl nesting area	Important sportfishery	Hydrologically important lake	073	10	4	1, 2, 4
207	Wiau Lake	Regional	Important waterfowl nesting area	Important osprey nesting area	Hydrologically important lake	074	09	4	1, 2, 4
208	Behan Lake	Regional	Hydrologically important lake	Commercial/domestic fishery	Important sportfishery	073	11	4	1, 2
210	Logan Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl nesting area	070	09	4	1, 2, 4
211	Heart Lake	Provincial	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	070	10	4	1, 2, 4
212	Francis Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	069	11	4	1, 2
213	Piche Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	070	11	4	1, 2
214	Dillon River	Regional	Hydrologically important river	Wildlife movement corridor	High wildlife diversity	075	02	4	1, 2
216	Christina Uplands Moose Area	Regional	Important moose habitat	High landform diversity	High vegetation diversity	078	08	4	1, 4
217	Christina River (Middle)	Regional	Important sportfishery	Significant meander reach	Wildlife movement corridor	079	06	4	1, 2, 3
218	Christina River (Upper)	Regional	Important sportfishery	Significant meander reach	Significant plant community	079	10	4	1, 2, 3
219	Rourke Creek	Regional	Important sportfish area	Important sportfish area	High landform diversity	069	26	4	1, 2
220	Lawrence Lake	Regional	Important waterfowl nesting area	Commercial/domestic fishery	Important sportfishery	069	25	4	1, 2, 4
221	Spotted Horse Lake	Regional	Important waterfowl nesting area	Important sportfish area	Hydrologically important lake	068	26	4	1, 2, 4
224	Bleigen Lake	Regional	Important raptor habitat	Important sportfish area	Hydrologically important lake	067	26	4	1, 2
225	Brereton Lake	Regional	Important osprey nesting area	Important sportfish area		067	26	4	1, 2, 4
226	September Lake	Regional	Important osprey nesting area	Important sportfish area	Hydrologically important lake	067	25	4	1, 2, 4
227	Francis Lake	Regional	Important bald eagle habitat			066	25	4	1, 2, 4
230	Pembina River	Regional	Important sportfishery	High landform diversity	Important ungulate habitat	066	02	5	1, 2
231	Quitting Lake	Regional	Important waterfowl nesting area	Hydrologically important lake		088	03	5	1, 2, 4
232	Round Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl nesting area	089	04	5	1, 2, 4
299	Snipe Creek OGF	Regional	Old-growth forest			095	17	4	1, 3
319	Gregoire Beach Ridge	Regional	Significant beach ridge feature	High wildlife diversity	High vegetation diversity	087	08	4	1, 3
321	Christina Slumps	Regional	Significant slump area	High landform diversity	High vegetation diversity	087	06	4	1, 3
328	Ells River OGF	Regional	Old-growth forest			096	11	4	1, 3
371	Trout River Delta	Provincial	High landform diversity	High wildlife diversity	High vegetation diversity	084	04	5	1, 3
389	Fawcett Diversity Area	Regional	High wildlife diversity	Rare vegetation species	High landform diversity	064	02	5	1, 3
391	Salteaux River Diversity Area	Regional	Significant dune fields	High landform diversity	High wildlife diversity	068	02	5	1, 3
392	Chisholm Dune Field	Regional	Significant dune fields	High vegetation diversity		069	01	5	1, 3
393	North Wabasca Springs/Seeps	Regional	Significant spring features	Significant escarpment feature	High vegetation diversity	081	25	4	1, 3
401	Landels River	Regional	Wildlife movement corridor	Important furbearer habitat	Important sportfishery	078	01	4	1, 2
423	Joslyn Creek OGF	Regional	Old-growth forest			096	11	4	1, 3
458	Iron Point Caribou Area	Provincial	Important caribou habitat	Significant channel fen		075	18	4	1, 3, 4
464	House River (Upper)	Regional	Important sportfishery	Hydrologically important river	Significant meander reach	079	13	4	1, 2

Table 1. Continued....

Site #	Site Name	Sig. Level	Significant Natural Features			Twp.	Rge.	Mer.	Map #
487	Athabasca River-Pembina Reach	National	Important sportfishery	Important moose habitat	High landform diversity	070	23	4	1, 2, 3, 4
489	Lesser Slave River	Regional	Important sportfishery	Important moose habitat	Wildlife movement corridor	071	01	5	1, 2
490	Meyer Lake/Chain Lakes	Regional	Important sportfishery	Important waterfowl nesting area	Important heron nesting area	069	24	4	1, 2, 4
493	Hubert Lake	Regional	Important heron nesting area			064	02	5	1, 2, 4
497	Fort Hills	Regional	LGK	High landform diversity	Important moose habitat	097	09	4	1, 2, 4
500	Birch Mountains Diversity Area	Provincial	High landform diversity	High vegetation diversity	High wildlife diversity	099	15	4	1, 3
505	Saulteaux River	Regional	Important sportfishery	Important moose habitat	High landform diversity	071	03	5	1, 2
518	Landels River Diversity Area	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	077	02	4	1, 3
519	Broken Springs	Regional	Significant spring features	Wildlife mineral lick		089	05	4	1, 3
524	McClelland Lake	Regional	Hydrologically important lake	Important waterfowl staging area	Important bald eagle nesting area	098	09	4	1, 2, 4
525	Pelican River	Regional	Hydrologically important river	High landform diversity		078	20	4	1, 2
526	Pelican Mountains Escarpment	Regional	Important moose habitat	Significant escarpment feature	High landform diversity	077	22	4	1, 3, 4
527	Parallel Creek Peatland	Provincial	Important caribou habitat	Significant channel fen	High landform diversity	076	19	4	1, 3, 4
529	McMillan Lake Moose Area	Regional	Important moose habitat	High landform diversity	High vegetation diversity	074	18	4	1, 4
531	Athabasca River-Rapids Reach	National	Important sportfishery	Significant rapids feature	Important moose habitat	087	17	4	1, 2, 3, 4
532	Athabasca River-Tar Sand Reach	National	Important sportfishery	Hydrologically important river	Important moose habitat	095	11	4	1, 2, 3, 4
533	La Biche River	Regional	Important sportfishery	Hydrologically important river		070	18	4	1, 2
534	Wabasca River (Canyon)	Provincial	Important sportfishery	High landform diversity	Important moose habitat	093	04	5	1, 2, 3, 4
535	Chipewyan Diversity Area	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	090	21	4	1, 3
538	Horse River Diversity Area	Regional	Significant dune fields	High vegetation diversity	High landform diversity	088	14	4	1, 3, 4
539	Algar Lake Peatland	Regional	Significant discharge fen	High landform diversity	Significant spring features	082	15	4	1, 3
540	Hospital Creek Diversity Area	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	087	02	5	1, 3
541	Equisetum Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl nesting area	089	05	5	1, 2, 4
543	Hunt Creek Diversity Area	Regional	Significant spring features	High landform diversity	High vegetation diversity	093	05	5	1, 3
544	Panny Tower Diversity Area	Regional	Hydrologically important lake	High landform diversity	High vegetation diversity	094	04	5	1, 3
545	Gordon Lake Diversity Area	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	086	03	4	1, 3, 4
546	Garson Lake	Regional	Important sportfishery	Significant spring features	Hydrologically important lake	084	01	4	1, 2
547	Watchusk Lake Diversity Area	Regional	High wildlife diversity	Hydrologically important lake	Hydrologically important creek	083	02	4	1, 3
550	Thickwood Hills	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	090	12	4	1, 3, 4
551	Tar River	Regional	Hydrologically important river	Significant meander reach		096	11	4	1, 2
552	Calumet River	Regional	Hydrologically important lake	Important otter habitat	Wildlife movement corridor	097	11	4	1, 2
554	Birch Mountains Escarpment	Regional	Significant glacial flutings	High vegetation diversity	Significant escarpment feature	096	15	4	1, 3, 4
555	Calumet Plains	Regional	Important moose habitat	High landform diversity	High vegetation diversity	098	11	4	1, 4
556	Clearwater Lake Diversity	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	095	17	4	1, 3, 4
557	Big Island Lake	Provincial	Important pelican nesting area	Important osprey nesting area	Important sportfishery	099	16	4	1, 2, 4
561	Square Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl staging area	068	12	4	1, 2, 4
562	Unnamed (Twin) Lake	Regional	Important sportfishery	Hydrologically important lake		070	13	4	1, 2
563	Unnamed (Mile 18) Lake	Regional	Important sportfish area	Hydrologically important lake		071	13	4	1, 2
564	Edwards Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	075	09	4	1, 2

Table 1. Continued....

Site #	Site Name	Sig. Level	Significant Natural Features			Twp.	Rge.	Mer.	Map #
565	Unnamed (Kimowin) Lake	Regional	Important sportfishery	Hydrologically important lake		083	01	4	1, 2
566	Unnamed Lake	Regional	Important sportfishery	Hydrologically important lake		100	15	4	1, 2
569	Trout Mountain Moose Area	Regional	Important moose habitat			089	02	5	1, 4
570	Touchwood Lake	Provincial	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	067	10	4	1, 2
571	Jackson Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	067	11	4	1, 2
572	Kinnaird Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	067	10	4	1, 2
573	Akuinu River	Regional	Hydrologically important river	Important furbearer habitat	Wildlife movement corridor	067	03	5	1, 2
575	Mistehae Lake	Regional	Important sportfishery	Commercial/domestic fishery	Important waterfowl area	080	02	5	1, 2
577	McGuffin Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	067	11	4	1, 2
578	Spencer Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	067	09	4	1, 2
579	Seibert Lake	Provincial	Important sportfishery	Commercial/domestic fishery	Important trophy fishing lake	067	09	4	1, 2, 4
580	Glover Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	075	09	4	1, 2
581	Jumbo Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	073	04	4	1, 2
582	Driftwood Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	085	02	5	1, 2
583	Long Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	090	02	5	1, 2
584	West Twin Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	090	04	5	1, 2
585	Horseshoe Lake	Regional	Important waterfowl area	Important sportfish area	Hydrologically important lake	065	02	5	1, 2
586	Gods Lake	Provincial	Important sportfishery	Important trophy fishing lake	Hydrologically important lake	090	02	5	1, 2
587	Brintnell Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	078	05	5	1, 2, 4
589	Unnamed (Hebephrenic) Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	090	02	5	1, 2
590	Royemma Lake	Regional	Important sportfishery	Commercial/domestic fishery	Hydrologically important lake	075	01	4	1, 2
591	Unnamed Lake	Regional	Important sportfishery	Hydrologically important lake		080	03	4	1, 2
592	Namur/Gardiner Watershed	Provincial	Important sportfishery	Commercial/domestic fishery	Important trophy fishing lake				1, 2
593	Winefred/Grist Watershed	Provincial	Important sportfishery	Important trophy fishing lake	Important furbearer habitat				1, 2, 4
594	Peerless/Graham Lake Watershed	Provincial	Important sportfishery	Commercial/domestic fishery	High wildlife diversity				1, 2
595	Unnamed (Sand) River	Regional	Important sportfishery	Important otter habitat	Hydrologically important creek	074	04	4	1, 2
598	Piche River	Regional	Important sportfishery	Hydrologically important river		070	11	4	1, 2
603	McClelland Lake Sinkholes	Provincial	Significant sinkhole features	Hydrologically important lake		098	09	4	1, 3
604	Surmont Diversity Area	Regional	High landform diversity	High vegetation diversity	High wildlife diversity	084	08	4	1, 3
605	Birch Mountain Caribou Area	Regional	Important caribou habitat	Important furbearer habitat		098	15	4	1, 4
606	Firebag Marten Area	Regional	Important furbearer habitat			100	07	4	1, 4
607	Wiau Caribou Area	Provincial	Important caribou habitat			074	10	4	1, 4
608	Christina Lake Caribou Area	Provincial	Important caribou habitat	Important furbearer habitat		077	05	4	1, 4
609	Dover-McKay Moose Area	Regional	Important moose habitat			093	13	4	1, 4
610	September Lake Moose Area	Regional	Important moose habitat			067	26	4	1, 4
611	Nipisi Lake Caribou Area	Provincial	Important caribou habitat			079	07	5	1, 4
612	Salteaux River Caribou Area	Provincial	Important caribou habitat			069	02	5	1, 4
613	Calumet Old Growth Forest	Regional	Old-growth forest			097	10	4	1, 3
614	Touchwood Old Growth Forest	Regional	Old-growth forest			067	09	4	1, 3

- **Map 2.** Significant Fish Habitats and Aquatic Features
- **Map 3.** Significant Vegetation and Terrain Features
- **Map 4.** Significant Wildlife Habitat Areas

It should be noted however, that while major environmental features were used to identify most of the sites, these were often not the only significant features found in the area. Most significant natural sites identified in the Eastern Boreal Forest Region study area are comprised of one to three key features and anywhere from one to 12 associated features. It should also be emphasized that selection of these significant natural sites was based on existing information and quite often, the information was extremely limited or outdated. The identification of significant natural sites should be considered an on-going process since additional areas meeting these criteria will undoubtedly be found as more information in the study area becomes available.

7.0 MANAGEMENT OF SIGNIFICANT NATURAL FEATURES

7.1 Terrain Features

Terrain is a general term that refers to the physical characteristics of a landscape. In the present study, terrain was used to refer to landforms, peatlands, surface water features, groundwater features, bedrock outcrops and soils. Terrain features contribute to landscape diversity and the scenic value of an area and may have important hydrologic or hydrogeologic functions. Environmentally significant terrain features identified in the Eastern Boreal Forest Region are summarized in Table 2 and shown on Map 3. Significant hydrologic features (watercourses, lakes and watersheds) are shown on Map 2.

7.1.1 Glacial Landform Features

Several significant features formed by glaciers or by meltwater from glaciers were recognized in the area, including:

- subglacial meltwater channels
- subglacial and preglacial deltas
- eskers and crevasse filling ridges
- meltwater outwash channels
- glacial flutings (Photo 1)
- hummocky moraine
- glacial lake beach ridges

Glacial landforms and materials have been mapped and described for the following parts of the region: Map Sheet 74E (Bayrock 1971), Map Sheet 74D (Bayrock and Reimchen 1971), Oilsands area (McPherson and Kathol 1975), Map Sheet 73L (Fenton and Andriashek 1989). The remainder of the area has not yet been inventoried.

7.1.2 Fluvial and Hydrological Features

The fluvial features recognized in this study are confined to active river valleys or glacial meltwater channels that were already identified as significant natural

Table 2. Significant terrain features in the Eastern Boreal Forest Region of Alberta.

Category	Name	Site #	Significance	Type of Feature
LANDFORMS:				
Glacial Features	Birch Mountains Escarpment	554	Regional	Glacial flutings
	Christina Lake/Jackfish River	78	Regional	Meltwater channel
	Fort Hills	497	Regional	Dissected kame
	Goodwin Lake	203	Regional	Meltwater channel lakes
	Gregoire Lake Beach Ridges	319	Regional	Beach ridges
	Hospital Creek Diversity Area	540	Regional	Eskers
	Logan River	202	Regional	Meltwater Channel
	Panny Tower Diversity Area	544	Regional	Dissected upland, wetlands
	Pelican Mountains	125	Regional	Eastern outlier of Boreal Foothills
	Pelican River Diversity Area	127	Regional	Crevasse fillings, meanders
	Thickwood Hills	11	Regional	Landform diversity
	Trout River	180	Regional	Subglacial channel
	Trout River Delta	371	Regional	Dunes, eskers, hummocky moraine
	Wappau Lake	79	Regional	Meltwater channel lake
Fluvial Features	Athabasca River - Pembina Reach	487	National	Meanders
	Calling River	148	Regional	Meanders
	Christina River - Middle Reach	217	Regional	Meanders
	Christina River - Upper Reach	218	Regional	Meanders
	Dover River	118	Regional	Incised meanders
	Ells River	18	Provincial	Meanders
	Firebag River	31	Provincial	Meanders, delta
	Mckay River	113	Regional	Incised meanders
Eolian Landforms	Algar Lake Sandhills	21	Regional	Sand dunes
	Chisholm Dune Field	392	Regional	Sand dunes
	Horse River Diversity Area	538	Regional	Sand dunes
	Owl River Diversity Area	11	Regional	Sand dunes

Table 2. Continued...

Category	Name	Site #	Significance	Type of Feature
Bedrock Outcrops and Geological Sections	Athabasca River - Rapids Reach	531	National	Rapids, outcrops
	Athabasca River - Tar Sands Reach	532	National	Bitumen outcrops, point bars
	Christina Slumps	321	Regional	Slumps
	Christina River - Lower Reach	158	Provincial	Canyon, slumps
	High Hill River	49	Provincial	Canyon, outcrops
	House River	93	Regional	Meltwater channel
	Wabasca River - Canyon Reach	534	Provincial	Canyon, outcrops
	Water Lily Lake Slumps	16	Regional	Slumps
	Whitemud Falls	6	Regional	Falls, outcrops
Karst Features	Eymundson Sinkholes	2	Provincial	Sinkhole lakes
	McClelland Lake Sinkholes	603	Provincial	Sinkhole lakes
PEATLANDS:	Algar Lake Peatland	539	Regional	Peatland diversity, springs
	Boivin Creek Peatland	22	Provincial	Channel fen
	Christina River Peatlands	28	Regional	Patterned peatland
	Clearwater Lake Diversity Area	556	Regional	Patterned peatland, permafrost
	Iron Point Peatland	458	Provincial	Peatland diversity
	McClelland Lake Fen	3	Provincial	Patterned fen
	Parallel Creek Peatland	527	Provincial	Diversity, channel/discharge fens
	Shultz's Bog Diversity Area	8	Provincial	Patterned fen
	Surmont Diversity Area	604	Regional	Diverse peatland, lakes, escarpment
HYDROLOGICAL FEATURES:	Broken Springs	519	Regional	Springs
	Clearwater Springs	5	Provincial	Saline springs
	High Hill River Springs	24	Provincial	Springs
	Hunt Creek Diversity Area	543	Regional	Springs
	La Saline Springs Natural Area	4	Provincial	Saline springs
	North Wabasca Springs and Seeps	393	Regional	Springs, seeps

Photo 1. Glacial flutings along the escarpment of the Birch Mountains. These landforms, which may provide one of the best examples of glacial flutings in Canada, are also characterized by high vegetation and wildlife habitat diversity.

features due to hydrologic function, fish and wildlife habitat, or vegetation and landform diversity. Features that are represented by good geomorphic examples include:

- meandering river reaches (numerous)
- incised meanders (McKay, Dover, and Ells Rivers)
- meanders in reaches in peatlands (numerous)
- floodplains (Tar Sands Reach of the Athabasca River)
- sand and gravel bars (Tar Sands Reach of the Athabasca River)
- slumping river valley sides (Wabasca, Christina, and Athabasca Rivers).

Other hydrological features of environmental significance include a number of large springs and seeps. Of particular importance are the large saline springs found along the Clearwater River and in the La Saline Natural Area (Photos 2 and 3).

7.1.3 Eolian Landforms

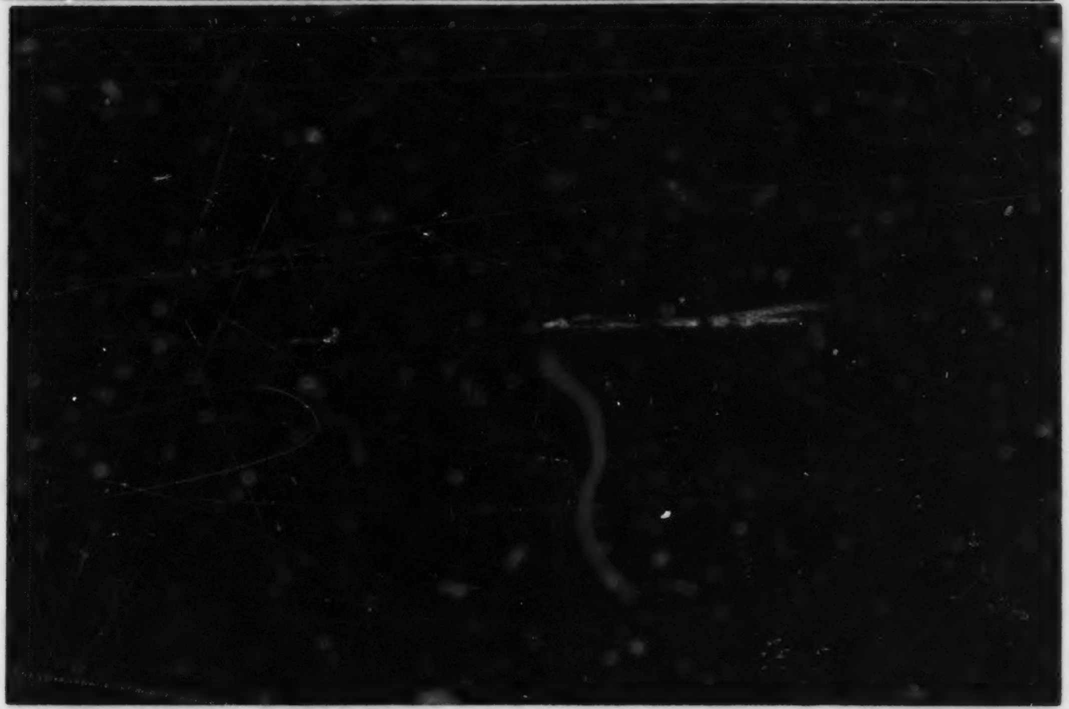
There are numerous areas of sand dunes and eolian veneers and blankets in the study area, especially in the Winefred and Christina basins. Areas selected as significant natural features of regional or greater significance had associated values that were additional to the eolian landform. The associated values were primarily high diversity of landforms, vegetation and wildlife habitat. The significant natural features also represent land-forming processes other than eolian.

The areas selected include:

- dune-peatland-lake diversity areas (Point Brule')
- subglacial delta, esker-dune complexes (Trout River Delta)
- glacial lake beach ridge-dune complexes
- glacial lake delta-dune complexes

7.1.4 Bedrock Outcrops and Geological Sections

The occurrence of bedrock outcrops and vertical sections is confined to the banks of deeply incised river valleys. For example, cretaceous-aged sediments are exposed in the canyon of the Wabasca River (Townships 92-94). The deeply incised



Photos 2 and 3. The springs (top) and tufa deposits (bottom) of the La Saline Natural Area are the best known example of saline springs in the Eastern Boreal Forest Region. Saline springs commonly support rare or unusual vegetation and are used as mineral licks by a number of wildlife species.

Rapids Reach of the Athabasca River provides approximately 110 km of exposed sections of Upper Cretaceous to Devonian-aged formations (Photo 4). The Tar Sands Reach of the Athabasca River provides numerous exposures of the Lower Cretaceous-aged McMurray Formation oil-impregnated sands and the underlying limestones of Upper Devonian age. The Whitemud Falls on the Clearwater River are formed by dolomites of Middle Devonian age (Photo 5).

There are also exposures of bedrock in the lower reaches of the Christina, Hangingstone, Horse, MacKay, Dover, Ells and Firebag Rivers. Exact locations of documented geologic type sections and any stratigraphic research sites are unknown at the present time.

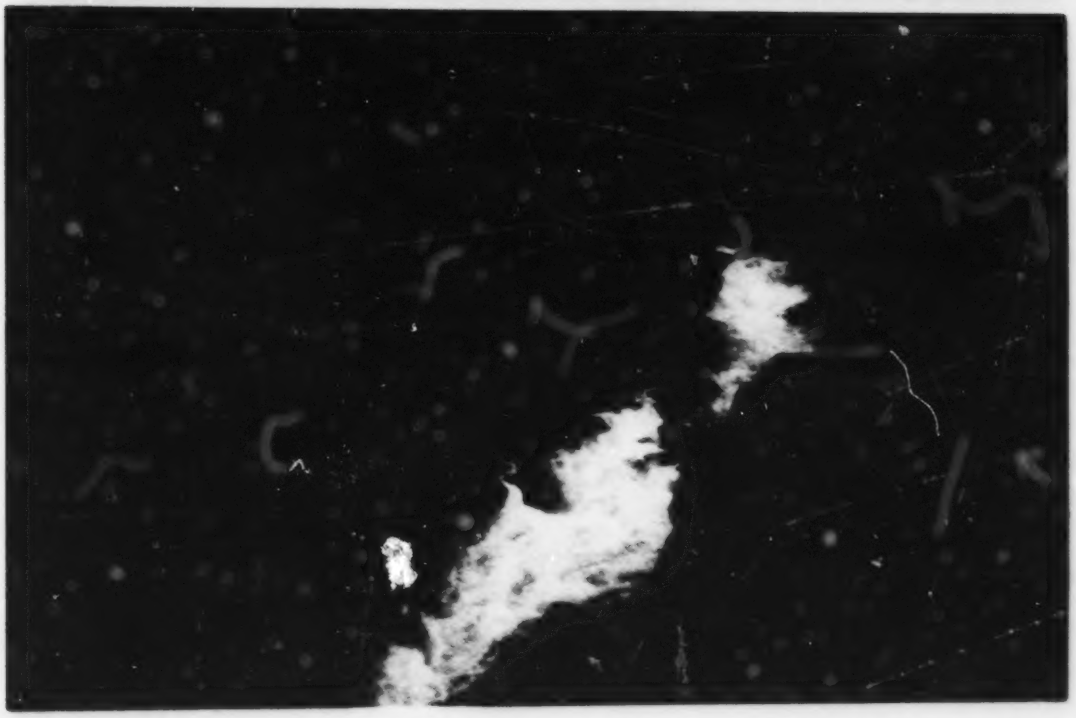
7.1.5 Karst Features

Karst features are rare in Alberta, except for the northeastern corner of the province where limestone and evaporite formations are near the land surface. Karst features identified in the area include sinkholes near the Athabasca River north of Fort McMurray, and a large subsidence area on the Christina River that is probably associated with a large sinkhole. All of these features follow the trend of the fault hypothesized by Carrigy (1959), and named the Sewetakun Fault by Hackbarth and Nastasa (1979).

7.1.6 Peatland Features

Peatlands cover an estimated 21% of the land area of Alberta (Zoltai 1988). The Eastern Boreal Forest Region contains some of the largest peatland complexes in the province, and within the study area, the proportion of the land area occupied by peatlands may be as high as 60%.

Peatlands are environmentally significant for a number of reasons. They are collectively important as a reservoir for surface water and for stabilizing stream flows. They may also serve as important wetland buffers, reducing the effects of siltation and other impacts resulting from land disturbance on aquatic habitats. Peatlands provide habitat for a diversity of wildlife species, and are of primary importance to species such as the threatened woodland caribou. The peatlands of the study region have also been the subject of considerable scientific interest, and



Photos 4 and 5. The Grand Rapids on the Athabasca River (top) and Whitemud Falls on the Clearwater River (bottom) are two outstanding examples of significant geological features in the Eastern Boreal Forest Region.

the results of botanical and paleoecological studies conducted in the region serve as important indicators of holocene climatic change in Alberta (Zoltai and Vitt 1990). This information will be valuable in predicting future changes in wetlands due to anticipated climatic changes.

The types of peatlands that exist in the region vary widely in relation to broad climatic differences that characterize the region. Zoltai et al. (1988) recognized two major wetland regions within the Boreal Forest Zone of Alberta. The Continental High Boreal Wetland Region, which includes the northern portion of the study region, is colder with discontinuous permafrost, and is characterized by patterned fens, peat plateaus, palsas, and flat bogs (Zoltai and Pollett 1983). The southern portion of the region is part of the Continental Mid-Boreal Wetlands Region, which is characterized by forested flat bogs and basin bogs associated with patterned fens, along with flat fens and basin fens in the absence of permafrost. Work is currently underway to classify and map the peatlands of the entire province (D. Vitt, pers. comm.).

Much of our understanding of the development and ecology of peatlands in western Canada has resulted from the excellent research conducted by Dr. Dale Vitt and his colleagues at the University of Alberta. These studies have shown that the peatlands of northeastern Alberta are comparatively young, with fen development and rapid peat accumulation occurring during the late Holocene period when the climate became cooler and moister (Zoltai and Vitt 1990). In Alberta, the oldest basal fen peat dates have been recorded in the foothills and along the eastern slopes of the Rocky Mountains (greater than 8100 years B.P.), and basal fen ages tend to become older with increasing distance from the prairie margin. Nicholson and Vitt (1990) found that the earliest peat accumulation near Mariana Lakes began around 8180 years B.P. but that extensive regional paludification occurred between 6000 years B.P. and 3000 years B.P. During this period extensive landform development occurred including bog islands, watertracks and forested fens.

The fundamental classification of peatlands is based on the supply of nutrients and the source of water entering the peatland (Vitt and Chee (1990). Ombrogenous peatlands receive water primarily from atmospheric precipitation, which is characteristically mineral-poor, while peatlands that are fed primarily by mineral-rich ground water are referred to as geogenous. The number of vegetation species present in peatlands reflects the underlying hydrotopographical and chemical gradient (Vitt and Chee 1990). In general, *Sphagnum* spp. dominated bogs are ombrotrophic and poorest in number of species, while fens are minerotrophic and richer in species. Three fen types, extreme-rich fens, moderate-rich fens and poor fens, have been distinguished in Alberta on the basis of chemical gradients (pH, nutrients, calcium, magnesium, and conductivity) and species associations. While poor fens are *Sphagnum* spp.-dominated, rich fens are dominated by brown mosses, including *Tomenthypnum nitens, Campylium stellatum, Bryum pseudotriquetrum, Meesia triquetra,* and *Drepanocladus revolvens* (Chee and Vitt 1989). Extreme-rich fens contain additional species indicative of highly calcareous conditions. Chee and Vitt (1989) found that most of the fens sampled in the Athabasca region were of the moderate-rich type, while the Mariana Lakes peatland was a poor fen (Vitt and Chee 1990).

Nicholson and Vitt (1990) concluded that the young minerotrophic wetlands of boreal Alberta are still rapidly expanding, and that ombrotrophic bogs were rare or still being developed. Within the study region, ombrotrophic bogs typically occur as small bog islands within peatland complexes. These areas are usually associated with elevated plateaus, ridges or drainage divides where minerotrophic runoff is limited.

Peatlands selected as significant natural features either: provide excellent examples of particular forms; have unusual diversity of form and vegetation; are thought to be groundwater discharge areas important for river flow; or comprise important habitat areas. These include examples of both open and forested non-patterned peatlands, patterned peatlands, ombrotrophic bogs, peatlands associated with permafrost features (plateau peatlands, raised or palsa bogs), discharge and channel fens, and saline fens. When it is completed, the inventory being conducted by

Dr. Dale Vitt of the University of Alberta will provide a much more complete inventory of peatland features in the Eastern Boreal Forest Region of Alberta.

7.1.7 Rivers and Streams

In addition to their vital hydrologic function, rivers and streams provide important fish and wildlife habitat, ecosystem diversity, and may contain interesting or unusual fluvial landforms. All rivers and streams shown on the 1:750,000 Alberta base map were initially identified as potential significant natural features. Some of these were later eliminated due to small size or lack of other values. Many of these would qualify as significant natural features of local importance, which were not considered in the present study. Based on these criteria, 66 rivers and streams were identified in the study area, three of which were considered as nationally significant, eight as provincially significant and 55 as regionally significant (Table 1).

7.1.8 Lakes

Lakes perform a vital hydrologic and often hydrogeologic function and provide habitat for fish and wildlife. All named and unnamed lakes of reasonable size on the 1:750,000 Alberta base map were initially identified as potential significant natural features. Some of these were omitted from the final list of significant natural features due to small size or lack of sufficient values to qualify as a regional site. Based on these criteria, 94 lakes were identified as significant features in the study area. Of this total, 15 lakes were considered as provincially significant and 79 as regionally significant (Table 1).

7.1.9 Management Considerations

7.1.9.1 Landforms

Many landform and geological features are quite insensitive to changes in vegetation cover. Sand dunes can become active if surface cover is disturbed or removed. The most threatening activities for environmentally significant landforms are intensive disturbance operations such as sand and gravel extraction, open-pit mining, road location, grading and levelling, and municipal and industrial development.

7.1.9.2 Peatlands, Rivers and Lakes

Peatlands, marshes, other wetlands, rivers and lakes all require maintenance of water levels and quality. Any activity that alters water level, flow regime or water quality within an environmentally significant area will result in some changes to that area.

Patterned peatlands, plateau peatlands and palsas in the discontinuous permafrost region of the study area are all sensitive to melt-out and subsidence if surface vegetation is removed. Numerous meltouts have occurred from clearing of seismic trails across these features.

7.2 Vegetation Features

7.2.1 Plant Species and Vegetation Communities

Rare vascular plant species were defined as those in recent lists for the province (Packer and Bradley 1984, Wallis 1986). These lists use the number of collection sites as a proxy for population size since virtually no studies have been done of the population status of plants in Alberta. Major herbaria in the province, the Provincial Museum accession records, and information of the Alberta Native Plant Council were searched for collections of rare vascular species from the study area. Due to difficulty of access, few collectors have visited the study area and therefore, distributional information is sparse. In addition, the location information for many collections from the study area is too general to be useful in this study.

There is no list of rare non-vascular plants for the province, for Canada or for North America although the American Bryological and Lichenological Society has begun preparing such a list (Vitt 1990). Disjunct or range boundary occurrences were also considered significant and an attempt was made to use existing range maps, such as Packer (1983) or Cody and Britton (1989). However, the patterns shown on these maps for the study area are largely an artifact of limited, inadequate collecting and often are not biologically meaningful. Thus, disjunct or range boundary occurrences could not be assessed in most cases for the study area.

The Trees of Renown data base was examined for the study area (Alberta Forestry Association 1990). Several trees or sites in the study area have been suggested but none has been adequately investigated or evaluated to be designated as a Tree of Renown.

There is no vegetation (plant community) classification for the study area or the province. Studies have been done of portions of the area (e.g. Eulert and Hernandez 1980, Lieffers 1984, Pedology Consultants 1982, Stringer 1976) but none provides a uniform, comprehensive classification of the study area.

7.2.2 Old-growth Forests

Interest and public awareness of old-growth forests have increased greatly in the past ten years (Juday 1978, 1988) although scientific interest and studies go much further back. Definitions of old-growth currently include both the age of the dominant trees as well as structural features such as heights, diameters, density and spacing patterns, snag density and characteristics, cavity characteristics, nutrient cycling and energy flow characteristics, and structural heterogeneity (Franklin et al. 1981, Greene 1988, Old-growth Definition Task Force 1986) although age is often used as an indicator of old-growth conditions. In addition to characteristics of the trees, old-growth conditions may include understory plants and animals that are restricted or highly dependent on old-growth forests.

Old-growth forests provide important habitat for many species of wildlife. As well as supporting diverse and abundant faunal communities, old-growth forests are inhabited by a group of wildlife that apparently evolved as specialists, taking advantage of the specialized habitats and unique structural characteristics of old-growth stands (Meslow et al. 1981). In a study of avifauna use of boreal habitats in northeastern Alberta, Francis and Lumbis (1979) found that mature mixedwood forests supported a greater density (515 breeding pairs/100 ha) and diversity (36 species) of breeding birds than did other forested or wetland habitats, and provided optimal habitat for the largest number of breeding bird species.

A wildlife group that relies almost exclusively on older forests comprises cavity dependent species. In northeastern Alberta, old-growth forests provide preferred habitat for cavity nesting birds such as the yellow-bellied sapsucker, pileated woodpecker, hairy woodpecker, black-backed three-toed woodpecker and red-breasted nuthatch (Francis and Lumbis 1979). Various researchers have reported that snag diameter is the most important determinant of habitat use by cavity nesting birds (Conner et al. 1975, Mannon et al. 1980, Raphael and White 1984). Snags of sufficient diameter for species such as pileated woodpeckers generally occur only in older forests.

Old growth forests also provide optimal habitat for a number of mammal species. Westworth et al. (1984) reported that at least 14 species of mammals use snags or deadfall for nesting, denning, hibernating, breeding, foraging or cover in boreal aspen forests of Alberta. They found that use of these habitats increased with increasing tree size (diameter) with the greatest use recorded in the oldest (over-mature) stands. In northeastern Alberta, conifer-dominated, old-growth mixed-wood forests likely provide preferred habitat for species including marten, fisher, northern flying squirrels, short-tailed weasels, dusky shrews, and several species of bats, which require large trees and snags as denning or roosting sites (Fairbarns 1991). Old-growth forests also provide important habitat for woodland caribou. During winter, caribou require an abundant supply of terrestrial and arboreal lichens, which are only associated with mature or overmature coniferous forests and treed muskegs (Edmonds 1986).

Old-growth forests also affect stream characteristics (Franklin et al. 1981) and provide material for tree-ring analyses that are currently used to study climatic change (Sheppard and Cook 1988, Whitney 1987).

The definition of old-growth forests, its age and characteristics, varies depending on the forest type (species composition) and geographic location. Most work to date on old-growth forests has been on coastal forests in western North America (Greene 1988) and little has been done to develop a definition for boreal forests such as those in the study area. The age of the oldest stands in a landscape such as the boreal forest is dependent on the frequency of large-scale disturbance. In the mixedwood forests of northern Alberta where large-scale fire disturbance generally recurs on an 86-112 year cycle (Fairbarns 1990), only a small proportion of the stands will be older than this (Achuff and La Roi 1977). Thus, stands older than about 125 years (longer than the mean fire cycle) should be considered old-growth at least provisionally at this time. Whether stands of this age in northern Alberta contain distinctive structural or compositional features is not clear and additional field studies are needed. Also, the use of tree height as an indicator of old-growth conditions needs further investigation.

The Phase 3 Forest Inventory (Alberta Forest Service 1990) provides limited information for the entire study area. The inventory contains information on canopy composition, density, and height as well as estimated age and stand location. The composition information is of limited use because deciduous species (aspen, balsam poplar, paper birch) are usually lumped together and balsam fir is seldom recognized although it is a common component of many white spruce stands in the area. The Phase 3 information on coniferous-dominated stands more than 100 years old was used to locate 12 stands of coniferous, old-growth forest in the study area. Information on deciduous-dominated stands was not available.

The Phase 3 data were sorted and analyzed using dBase III+ and Lotus 1-2-3 to select stands with certain age and composition characteristics in various parts of the study area. These stands were then located on 1:15,000 Phase 3 forest inventory maps to determine which stands were adjacent to other selected stands in the same or adjacent townships. From these and following the field reconnaissance, 14 stands were selected for significant natural feature status (Table 3, Map 3). Additional areas and concentrations of potential old-growth stands were tentatively identified during this process but there was not time available to evaluate them further(Figure 3, Appendix I).

7.2.3 Management Considerations

7.2.3.1 Plant Species

Little is known of the local population size and distribution, specific life history or habitat requirements of the rare or significant plant species in the study area. Until

Table 3. Significant old-growth stands in the Eastern Boreal Forest Region.

Old-growth Forest	Site #	Significance	Description/Comments
Banana Lake	84	Regional	• Old-growth black spruce - tamarack forest • 175 years old, 98 ha
Christina Crossing	33	Regional	• Old-growth jackpine forest • 185 years old, 110 ha
Christina River	42	Regional	• Old-growth alluvial white spruce forest • 175 years old, 115 ha
Edwin Creek	46	Regional	• Old-growth alluvial white spruce forest • 215 years old with some 155 year old stands in adjacent upland, 102 ha • Extensive cutting of other stands in the area has already occurred
Ells River	328	Regional	• Old-growth alluvial white spruce and balsam poplar forest • !70 years old, 114 ha
Ells Tower	175	Regional	• Old-growth upland white spruce forest • 175 years old, 215 ha
Firebag River	186	Regional	• Old-growth alluvial white spruce forest • 170 - 190 years old, 623 ha • Some cutting has already occurred in the area
Hunt Creek	197	Regional	• Old-growth upland white spruce forest • 155 years old, 501 ha
Joslyn Creek	423	Regional	• Old-growth jackpine forest • 150 years old, 159 ha
Mink-Grew Lakes	53	Regional	• Old-growth black spruce forest • 195 years old, 33 ha
Pelican	124	Regional	• Old-growth black spruce forest • 205 - 255 years old • Boreal foothills outlier
Snipe Creek	299	Regional	• Old-growth white spruce forest • 165 years old, 595 ha
Calumet	613	Regional	• Old-growth balsam poplar forest • 175 years old
Touchwood Lake	614	Regional	• Old-growth white spruce and balsam fir forest • 120-[illegible] years old • Recent fire history (60+ years)

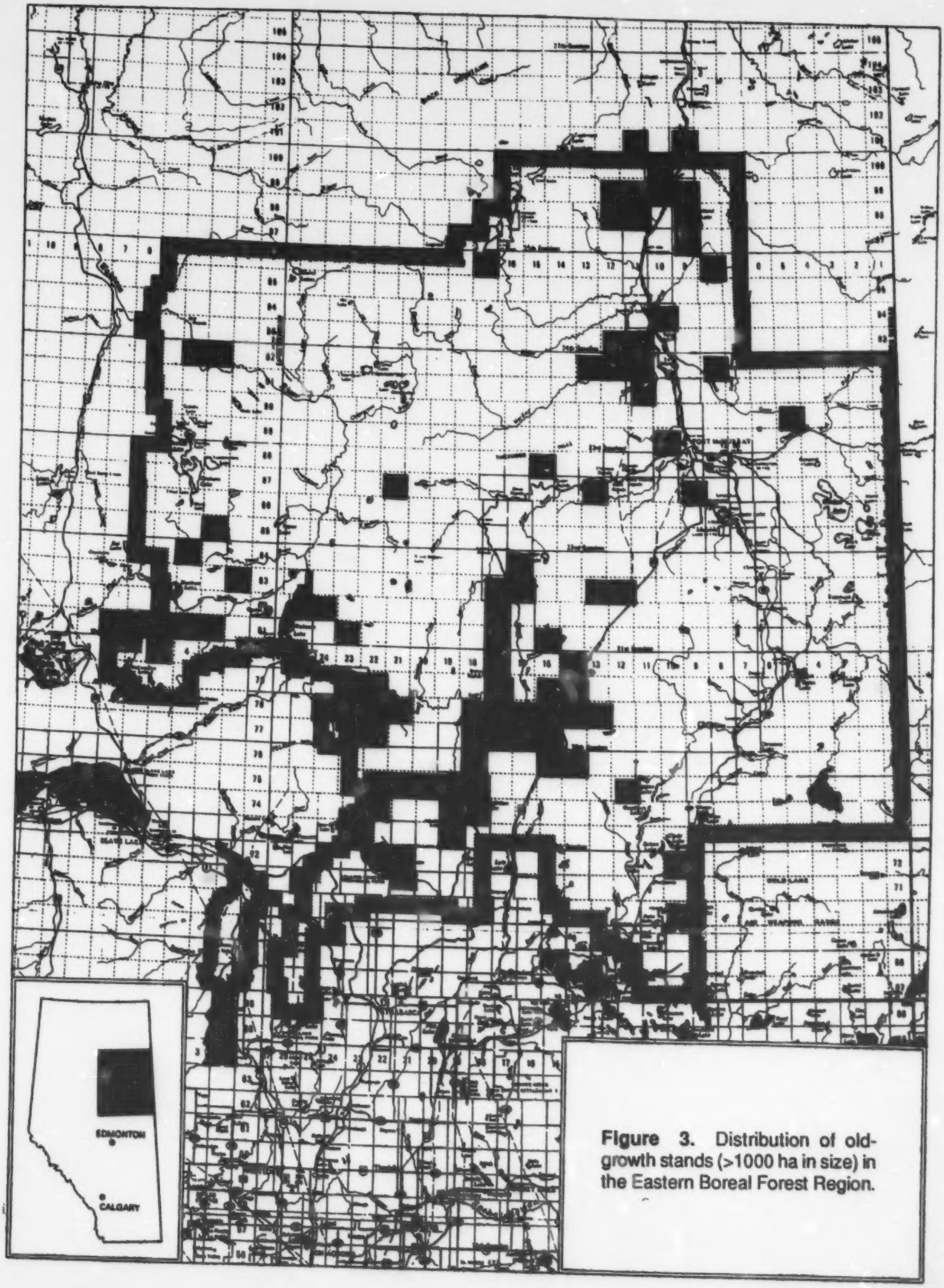

EDMONTON
CALGARY
FORT McMURRAY
SLAVE LAKE

Figure 3. Distribution of old-growth stands (>1000 ha in size) in the Eastern Boreal Forest Region.

studies can be done to define these, the best management will be to conserve them in areas of undisturbed habitat. Monitoring should be done to determine the continuing state of these species. In general, more extensive areas of habitat are preferable to smaller ones because more extensive areas generally contain larger, more viable populations, sustain less edge-effect from adjacent disturbances, and are better buffers against disturbances. Consideration should also be given to areas of connecting habitat that link natural populations and to the isolation of particular types of habitats (island effect) by forest harvesting, tar sands development or other disturbances.

7.2.3.2 Old-Growth Forests

Guidelines do not currently exist governing the proportion or amount of old-growth forest required to maintain the full diversity of old growth species within the boreal mixedwood region. It is probably not helpful to establish a percentage guideline without first identifying the amount of habitat required to maintain viable populations of old-growth dependent species that currently occur in the region. These requirements can be expected to vary widely between species. For example, in west-central Alberta the Alberta Fish and Wildlife Division has secured the cooperation of several forest companies that will allow 30-50% of the forest in primary habitat areas to be maintained at 80-120 years of age (Edmonds 1986). There is clearly a need to develop an old-growth strategy for the Eastern Boreal Forest Region that will ensure that the biological diversity that presently characterizes the region is maintained and that populations of old-growth dependent wildlife species remain viable. As part of this strategy there is a need to consider not only the amount of old-growth habitat required, but the temporal and spatial arrangement of this habitat. Fairbarns (1991) provides an excellent review of the issues of block size, habitat fragmentation, biological corridors and other concepts relevant to old-growth forest management in the Boreal Mixedwood Forest Section.

While old-growth stands are often better protected from disturbance than other parts of the landscape, they still have a real probability of being disturbed especially by fire or by blowdown, if adjacent areas are cut. Thus, the continued conservation of old-growth stands would be best ensured by the continued existence of intermediate-age stands (perhaps 80-120 years) in areas adjacent or close to existing old-growth areas. Such younger age areas would serve as a buffer and bridge habitat for old-growth species that may be poor dispersers and would also serve as a source of future recruitment for old-growth stands.

The ecology of old-growth forests in northern Alberta is poorly understood. Further studies are needed of the composition, structure and dynamics of old-growth forest in the boreal mixedwood region to gain a clearer understanding of forest regeneration processes and of the life history characteristics of the component species. In the absence of this information, the best management strategy for old-growth forests at this time is to conserve large blocks that include the full diversity of forest community types and to locate them in various parts of the study area to reduce the potential effects of catastrophic disturbance.

7.3 Wildlife Resources

7.3.1 Waterfowl

7.3.1.1 Status

Waterfowl are the most prominent and economically important group of migratory birds in North America. In addition to being highly prized as game birds, they attract large numbers of people who enjoy observing them, and are recognized as indicators of a healthy environment. Despite their importance and high profile, however, a significant decline has occurred in the North American waterfowl population. Large-scale alterations to wetland and upland habitats by agriculture, urbanization, and industry have affected the distribution and abundance of many duck species. Those species that have been affected the most include the northern pintail (*Anas acuta*), mallard (*Anas platyrhynchos*), blue-winged teal (*Anas discors*), and canvasback (*Aythya valisineria*). Populations of these species have declined markedly (approximately 65% for the pintail) since systematic population surveys began in the mid-1950s (CWS and USFWS 1986). As changes to the landscape continue, reduced rates of habitat loss and continued maintenance and restoration of wetlands is essential for the survival of waterfowl and other wildlife species.

Breeding densities of waterfowl in the boreal mixedwood region of northern Alberta are typically lower than those of the prairie pothole region. However, a number of lakes and wetland complexes are significant for either production, moulting, or spring and fall staging. As well, wetland habitats of this region become more important during periods of drought when the availability of suitable breeding habitat decreases in the prairie-parkland region. In recent years, a large portion of Alberta ducks by-passed their traditional breeding areas on the drought-stricken prairies to breed on the more permanent waterbodies in the parkland and boreal forest (Calverley, pers. comm.).

There is a lack of current information on waterfowl densities over much of the Eastern Boreal Forest Region study area. During the 1970s, studies conducted under the auspices of the AOSERP program, and independent studies by oilsands companies, provided information for the northern part of the region. Alberta Fish and Wildlife personnel (north-east region) have recently collected a limited amount of data for some of the more accessible waterbodies along the southern boundary of the region. Canadian Wildlife Service personnel have flown survey transects over the northern half of the province for many years, but the information is very general and fails to identify the more important waterbodies and wetland complexes (Turner, pers. comm.). Because no current inventories have been conducted, comprehensive information for much of the western portion of the study area is virtually non-existent (Moyles, pers. comm.).

7.3.1.2 Major Species and Habitat Use

Diving Ducks

The group of divers includes all species of ducks that dive below the water surface to forage for food. Divers were the most prevalent group of ducks using oilsands wetlands, outnumbering all others by a ratio of 5:1 (Hennan and Munson 1979). The most numerous species in order of abundance were lesser scaup (*Aythya affinis*), ring-necked duck (*Aythya collaris*), bufflehead (*Bucephla albeola*), and common goldeneye (*Bucephla clangula*). Breeding densities of divers were highest on wetlands vegetated with a zone of emergents or wet meadow along the edge, and shrubs or coniferous trees next to the edge. Slightly lower densities were recorded on waterbodies with either a continuous coniferous forest edge or that of emergent vegetation surrounded by a wet sedge meadow.

Breeding densities and wetland preference are related to individual species ecology and habitat requirements. Lesser scaup and ring-necked ducks prefer to nest in the sedge, grass, and shrub cover along wetland margins. The ring-necked duck reaches some of its highest breeding densities in the closed boreal forest of the province (Bellrose 1976). The bufflehead and common goldeneye nest in the cavities of trees, usually old woodpecker holes. Although the breeding range of both is extensive in the boreal forest of Canada, the most important breeding area for buffleheads is centered within the boreal mixedwood forest of Alberta (Bellrose 1976). Buffleheads usually nest within 25 m of water in old northern flicker (*Colaptes auratus*) holes. The availability of nest sites is determined by (1) the number of flickers excavating new cavities, (2) the durability of existing ones, and (3) competition with other species. As with all cavity-nesting ducks, buffleheads demonstrate a remarkable propensity to return in subsequent years to the same nesting area (Erskine 1961).

Dabbling ducks

This group includes all the surface-feeding ducks of the region. In the oilsands area, the most numerous species in order of abundance are mallard, American wigeon (*Anas americana*), green-winged teal (*Anas crecca*), and blue-winged teal (Hennan and Munson 1979). Dabblers prefer to breed on wetlands with a shoreline of emergent vegetation (primarily cattail) and either a wet meadow or shrub zone next to the edge although they also may be found in waterbodies that have a shrub margin adjacent to a mixed forest. Although most species of dabbling ducks are more numerous in the prairie-parkland region, many achieve high densities on the more permanent waterbodies of the boreal mixedwood region.

Other species

Nesting loons and grebes have been described as being numerous over much of the study region (Smith 1975, Hennan and Munson 1979), but there is no information documenting breeding pair densities. The common loon (*Gavia immer*) inhabits freshwater lakes during the breeding season, with only one pair per lake except where the lake is large (Godfrey 1986). It is sparsely distributed throughout the boreal mixedwood forest, and tends to prefer more remote waters with little human disturbance. Although it too prefers less disturbed areas, the western grebe (*Aechmophorus occidentalis*) nests in loose colonies on larger lakes (Godfrey 1986). The nest consists of floating vegetation mat near the shoreline emergent zone. Because it is more gregarious than other species of grebe, it is quite susceptible to disturbance from power boats, the cause of its disappearance from other, previously preferred lakes. There may be breeding colonies of western grebes at Gordon and Birch Lakes (Francis and Lumbis 1979), but given the number of large lakes within the study area, these are not likely to be the only locations. Many pairs of the red-necked grebe (*Podiceps grisegena*) have been observed to nest on other waterbodies in the study area (Hennan and Munson 1979, Burns et al. 1982).

7.3.1.3 Important Waterbodies in the Region

Hennan and Munson (1979) reported that both diving and dabbling ducks prefer to breed on waterbodies with a shoreline of emergent vegetation, combined with a vegetation zone near the edge ranging from wet meadow to shrub and mature forest. Similar conclusions were obtained from a waterfowl study in the vicinity of Utikuma Lake, just outside the present study area (Donaghey 1974). The results also showed that, although secondary in importance, slow-flowing, shallow streams and rivers with good nesting cover received substantial use by breeding dabbling ducks. Donaghey (1974) also reported that all ducks appeared to make less use of lakes containing northern pike (*Esox lucius*) than any other type of small lake sampled.

Although only a small percentage of the wetlands have been sampled, some waterbodies within the Eastern Boreal Forest Region study area have been identified as being regionally or provincially significant to waterfowl as either breeding, moulting, or staging areas (Table 4). Schick and Ambrock (1974) concluded that "the breeding pair densities at Gordon, Saline, and Horseshoe Lakes, and a few smaller wetlands, were comparable to those of prairie wetlands". A few of the lakes are also very important to waterfowl as moulting and spring/fall staging areas during migration. Maximum numbers observed at Gordon and McClelland Lakes during 1972 and 1973 fall surveys totalled 41,520 and 23,405, respectively (Schick and Ambrock 1974). Winefred and Gordon Lakes are heavily used during the moulting period, prior to the onset of fall migration (Turner, comm.). It may be that waterbodies in the study area derive some potential significance from their proximity to the Peace-Athabasca Delta (Burns et al. 1982). It is known that many thousands of ducks, geese, and swans from the Delta migrate through the study area as they disperse primarily along the Central and Mississippi flyways (Bellrose 1976, Ward et al. 1976). However, the paucity of data for most of the waterbodies within the study area would suggest that numerous other small wetlands are potentially important for waterfowl.

7.3.1.4 Management Considerations

The scarcity of information reflects the fact that most of the study area is inaccessible, except by aircraft. Because the area is large, comprehensive wildlife inventories over this region of the boreal mixedwood region have not been conducted recently. However, with current proposals for widespread forestry development and an additional oilsands plant within this unique ecosystem, it is imperative that the potential effects of these developments on major ecological features be assessed prior to development. For example, as with any other major river system, the Athabasca River valley is a prominent pathway for many types of migratory birds. Estimates of migrant waterfowl populations passing through the Eastern Boreal Forest Region study area may exceed 1.5 million birds annually (Peace-Athabasca Delta Project Group 1972).

Of those species discussed, loons, grebes and cavity-nesting ducks would likely be the most vulnerable to impacts resulting from forestry development. The northern

Table 4. Waterbodies in the Eastern Boreal Forest Region containing significant breeding, moulting or staging habitats for waterfowl.

Waterbody	Breeding	Moulting	Staging	Site #	Significance
Algar Lake	✓	✓	✓	101	Regional
Bohn Lake	✓			89	Regional
Bruntnell Lake	✓			587	Regional
Christina Lake	✓			78	Regional
Clyde Lake	✓			205	Regional
Cowper Lake	✓			88	Regional
Equisetum Lake	✓			541	Regional
Gardiner Lakes			✓	17	Regional
Goodfish Lake	✓			187	Regional
Gordon Lake	✓	✓	✓	26	Provincial
Graham Lake	✓		✓	183	Regional
Gregoire Lake			✓	65	Regional
Horseshoe Lake	✓	✓	✓	19	Regional
Kearl Lake			✓	36	Regional
Lawrence Lake	✓	✓	✓	220	Regional
Logan Lake	✓			210	Regional
Long Lake	✓			23	Regional
Maria Lake	✓			182	Regional
McClelland Lake			✓	524	Regional
McLeod Lake	✓			139	Regional
Meyer Lake	✓			490	Regional
Muskwa Lake	✓		✓	146	Regional
Nipisi Lake	✓		✓	152	Regional
Peerless Lake	✓		✓	184	Provincial
Pelican Lake	✓		✓	128	Provincial
Quitting Lake	✓			231	Regional
Rock Island Lake	✓	✓	✓	150	Regional
Round Lake	✓			232	Regional
Saline Lake	✓		✓	004	Provincial
Sandy Lake	✓		✓	135	Regional
South Wabasca Lake	✓		✓	133	Regional
Spotted Horse Lake	✓			221	Regional
Square Lake		✓	✓	561	Regional
Vandersteene Lake	✓		✓	185	Regional
Weaver Lake	✓			138	Regional
Wiau Lake	✓			207	Regional
Winefred Lake		✓	✓	90	Provincial

flicker, on which the bufflehead depends for nesting sites, is the most ubiquitous and numerous of the woodpeckers in the area (Francis and Lumbis 1979). Large scale loss of timber would reduce the number of available flicker territories in the region. A reduction in the flicker population would most likely be followed by a concomitant decline in the numbers of breeding buffleheads. While perhaps less affected by the actual loss of trees, common loons and western grebes may be impacted by an inevitable consequence of development, increased accessibility. More abundant, upgraded roads allow easier access into areas previously inaccessible for hunting, cottaging, and other recreational uses. Water-based activities on lakes, especially the use of power boats, can have a serious impact during the breeding season; the period during which loons and grebes are most sensitive to disturbances. Disturbances near the shoreline of waterbodies can have similar detrimental effects. Therefore, it is important that habitat integrity is preserved, and access is controlled or restricted within environmentally significant waterbodies during the breeding season.

7.3.2 Colonial Nesting Birds and Sensitive Avian Species

7.3.2.1 American White Pelican

Status

Since the turn of the century, 26 American white pelican colonies have been abandoned in Canada and the population appeared to be declining (Markham 1978). As a result, the white pelican was designated as a threatened species in Canada by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Recently, however, improved breeding performance by white pelican colonies in some areas of Canada has resulted in a delisting of the species to non-threatened status. The current estimate of the number of active breeding colonies in Alberta is approximately 12, but this number varies on an annual basis because pelicans will often abandon colonies in some years and return to them in other years. While the number of breeding birds may be increasing, however, the number of active colonies in Alberta is decreasing. For this reason, the white pelican is still regarded as an endangered species in Alberta (Brechtel, pers. comm.).

There were seven known breeding white pelican colonies in the north-central portion of the province in 1985 (Stepney 1987). Of these, four colonies were located within the present study area and include Pelican Lake, Namur Lake, Big Island Lake and Birch Lake (Table 5) (Photo 6). Although not all lakes were surveyed each year, most recent estimates suggest that Pelican Lake had approximately 200 nests, Namur Lake 135 nests, and Birch Lake 20 nests (Stepney 1987, Alberta Fish and Wildlife Division 1990). This represents approximately 60% (355/585) of the breeding population in northern Alberta (included in the total for northern Alberta are approximately 30 nests from Utikuma Lake and 200 from Mountain Rapids on the Slave River).

Breeding Biology and Habitat

White pelicans typically have a life span of 12 to 14 years, an age which is not unexpected in large birds with a low annual recruitment rate (Houston 1972). The normal clutch size is two eggs (Godfrey 1986), but juvenile mortality is often high. Studies indicate that the average number of young raised from a nest is less than one (Hosford 1965).

Of the seven nesting colonies visited in 1985 in north-central Alberta, five were located on lakes that were characterized by:

- overall shallow water depths of 1.8 - 6.1 m (6 - 20 ft),
- cloudy or turbid water,
- an essentially non-vegetated island with a sand or soil surface over at least a portion of it,
- an island that is above wave reach, and
- remoteness from areas of human activity (Stepney 1987).

In addition, the more successful colonies are located on lakes (with the exception of the Slave River Colony) with abundant yellow perch (*Perca flavescens*) and lake whitefish (*Coregonus clupeformis*) populations. Brook stickleback (*Culaea inconstans*) also appear to be numerically important in the diet, while invertebrates increase in dietary importance in areas where healthy fish populations are not present (Ealey 1979). Pelicans are surface feeding birds that benefit most from foraging on

Table 5. Location, number of active nests, and the most recent year surveyed for colonial nesting and sensitive bird species found in the Eastern Boreal Forest Region.

Waterbody	Site #	Significance Level	Species [1]				
			AWPE	DCCO	GBHE	BAEA	OSPR
Banana Lake	84	Regional					1(?)
Big Island Lake	557	Provincial	24('75)[2]			2('90)	2('90)
Birch Lake	60	Provincial	+120('80)	?('90)			
Brereton Lake	225	Regional					1(?)
Calling Lake	149	Regional				1('90)	
Clearwater Lake	556	Regional				1('90)	
Clyde Lake	205	Regional				1('86)	
Francis Lake	227	Regional				1('86)	
Gardiner Lakes	17	Regional				2('90)	
Goodwin Lake	203	Regional			6('86)	1('90)	1(?)
Graham Lake	183	Regional		2('80)			
Gregoire Lake	65	Regional				1('?)	
Heart Lake	211	Regional			30('90)	1('90)	
Hubert Lake	493	Regional			50('90)		
Logan Lake	210	Regional				1(?)	
McClelland Lake	524	Regional				1('81)	
Meyer Lake	490	Regional			6('79)		
Namur Lake	7	Provincial	135('90)				
Pelican Lake	128	Provincial	150('85)	+100('80)	57('78)	1('90)	
Sand Lake	15	Regional				1('90)	2('90)
Seibert Lake	578	Provincial					2(?)
September Lake	226	Regional					1('86)
Unnamed Lake	145	Regional		?('90)	?('90)		
Wappau Lake	79	Regional				1('90)	
Wiau Lake	207	Regional					1('86)
Winefred Lake	90	Provincial		8('82)	12('86)	2(?)	

[1] AWPE - American white pelican; DCCO - double-crested cormorant; GBHE - great blue heron; BAEA - bald eagle; OSPR - osprey

[2] Numbers in parentheses indicate the most recent year surveyed.

Photo 6. A number of lakes in the Eastern Boreal Forest Region provide important breeding habitat for colonial nesting bird species such as the white pelican and double-crested cormorant. These include Big Island Lake (photo) and Namur Lake in the Birch Mountains Diversity Area and Birch Lake in the Clearwater Lake Diversity Area.

schooling fish, such as perch and whitefish, that inhabit the mid- to upper portions of the water column. The shallows are used by white pelicans to herd fish toward shore where they are captured more easily.

In addition to actual breeding lakes, the white pelican has been known to use numerous waterbodies in the vicinity of the nesting lakes as foraging and loafing lakes (Trottier and Breneman 1976). Studies conducted in the Namur Lake-Birch Lake area have determined that white pelicans may fly considerable distances (30 - 69 km) to reach suitable foraging habitat (Ealey 1979, Beaver and Ballantyne 1979). These distances were comparable to those recorded for other breeding colonies of pelicans, although much longer flights have been documented elsewhere in North America (Behlen 1958, Johnson 1976). Several lakes identified as significant, including Mink Lake (162), Grew Lake (163) and Buffalo Creek Lake (104) are also known as staging locations for the white pelican.

Management Considerations

Because of their exceptionally low tolerance to disturbances during the reproductive period (Vermeer 1970), disturbance at the breeding site is the most serious threat to the white pelican in Alberta at the present time. Sensitivity is particularly high during territory establishment, egg laying and incubation, but seems to decrease somewhat after hatching. During the initial stages of incubation, one or two visits to a colony can cause abandonment of the colony site for the rest of the year. Repeated harassment of the breeding colony may result in permanent abandonment. Vermeer (1970) reported that at least 10 colonies have disappeared from Canada between 1950 and 1971 because of direct human interference, or because of man-induced habitat changes. Human disturbance can also have serious consequences for reproduction, even though the colony may not be permanently abandoned, by lowering nesting success.

7.3.2.2 *Double-crested Cormorant*

Status

Double-crested cormorants (*Phalacrocorax auritus*) reach the northern and western limit of their breeding range in Alberta (Godfrey 1986). In 1967, only four breeding colonies totalling less than 200 nests were documented in the province (Vermeer 1969a). For the purpose of protecting breeding sites, the double-crested cormorant was declared an 'endangered species' under the Provincial Wildlife Act in 1977, and breeding colonies were designated as 'Prohibited Access Areas'. The 1980 population of more than 2300 nests in 27 colonies represents a 1200% increase over the 1967 breeding population (Brechtel 1981). As a result of this increase, the species has recently been delisted in Alberta.

Breeding Biology and Habitat

Double-crested cormorants nest colonially near water, on the ground and less often in trees, in association with other colonial species such as gulls, pelicans or herons. They lay 3 - 4 eggs in a moderately bulky nest of sticks, rushes or other aquatic vegetation. Cormorants are fish-eaters, and in Alberta, they prefer to breed on larger shallow lakes with abundant fish populations. Breeding colonies have been located on four lakes within the Eastern Boreal Forest Region study area (Table 5). These colonies had a combined total of at least 110 nests in the early 1980s (Brechtel 1981), but since individual colonies are subject to drastic fluctuations in reproductive output (Brechtel, pers. comm.) and no recent surveys have been conducted in the region, the current status of these colonies is unknown at the present time.

Management Considerations

Human disturbance at the breeding colony is a major threat to double-crested cormorants in Alberta. Although somewhat more tolerant to human disturbance than pelicans, harassment of breeding cormorants can result in colony abandonment or loss of production (Brechtel, pers. comm.). Disturbance has a particularly negative effect during the incubation and early nestling period when unprotected eggs and young are most vulnerable to temperature fluctuations and avian predators. Disruptions of colonies may be expected to increase in the study area with increased development and improved access to lakes that were previously inaccessible to most forms of motorized transport.

Critical habitat areas, including those used for foraging, should be identified for each cormorant colony. Appropriate protection programs may then be implemented, especially those that include restricted access to waterbodies identified as environmentally significant during the breeding season. Although only a small portion of the provincial population is present in the study area, these colonies should be given special consideration because of recent outbreaks of avian cholera and Newcastle's disease at the Lac La Biche colony. Approximately 1,000 cormorants were lost to cholera in the summer of 1988, and 300 were presumed to have died from Newcastle's disease in 1990 (Pybus, pers. comm.). Certain strains of the Newcastle's virus are extremely deadly to fowl, and an epidemic can decimate entire populations.

7.3.2.3 Great Blue Heron

Status

Within Alberta, the great blue heron (*Ardea herodias)* is found on waterbodies and along waterways throughout the prairie, parkland, and southern boreal forest ecological regions (Godfrey 1986). There may be between 70 and 90 active breeding colonies in the province, and the population appears to be relatively stable, although fluctuations in local populations may occur (Brechtel, pers. comm.). The breeding effort is well distributed between the colonies, with no individual colony supporting a large percentage of the population. Reproductive output, however, may be decreasing slightly. Vermeer (1969b) reported an average of 2.5 young fledged per nest in 1968. This had decreased to approximately 2.0 young per nest in 1974 (Fisher 1979) and 1978 (Danielson 1978).

Breeding Biology and Habitat

The great blue heron forages in open shallow waters of lakes, rivers, and streams, feeding primarily on fish and other small vertebrates. It commonly lays 3 - 5 eggs in a nest located in the upper strata of a stand of deciduous, mixedwood, or less often, in coniferous trees (Godfrey 1986). In Alberta, 70% of the active colonies are located on lakes and 30% near rivers, usually at a considerable distance from water (Brechtel 1981). The majority of heron nesting sites in the province are only used by this species, but some mixed colonies comprised of herons and either double-crested cormorants or black-crowned night herons (*Nycticorax nycticorax*) also occur. If suitable conditions prevail, established nesting areas are used in successive years. Six colonies have been identified within the study area, with the largest (50 - 60 nests) occurring on Pelican Lake (Table 5).

Management Considerations

Great blue heron colonies, normally found in less remote areas than those of pelicans or cormorants and often located on the mainland, are generally more accessible than those of other colonial species. However, great blue herons tend to nest in high trees and exhibit greater tolerance to disturbances than other colonial nesting species. Although particularly sensitive during the breeding season, herons have the ability to habituate to many types of disturbances. It appears that consistent or expected disturbances are less disruptive than unexpected disturbances, and after a period of time, may be tolerated by herons (Grubb 1978, Nordstrom 1980). As with other colonial nesting species, however, harassment of breeding great blue herons can lead to decreased reproduction or colony abandonment. Intense, poorly timed, or unexpected disturbances are often the most detrimental, ultimately lowering the reproductive output of a colony (Werschkul et al. 1976, Brechtel 1981).

Loss of habitat has been cited as the most important factor leading to declines in the great blue heron populations of five mid-western states (Thompson 1978). Because the Eastern Boreal Forest Region study area is at the northern limit of its range, the impending loss of nesting habitat is not expected to severely affect the great blue heron population in Alberta. This is not to mean that the birds within the study area will not be affected. Large-scale industrial activity could result in abandonment of nesting colonies and loss of alternative nesting habitat.

7.3.2.4 Other Sensitive Species

As a group, raptors are the most intolerant to human activities near the nest site. The most notable species within the study area include the bald eagle (*Haliaeetus luecocephalus*) and the osprey (*Pandion haliaetus*). Both species may be found on numerous waterbodies throughout the study area (Table 5). Ospreys subsist entirely upon fish and the eagle, while primarily a fish-eater, may prey upon other available food sources and scavenge carrion. Both prefer to nest high in a tree beside a larger river or lake, and in most cases, the nest is used for many years. The bald eagle is a particularly long-lived bird that is slow to mature (4-5 years) and has a low reproductive output, averaging 2 eggs per clutch (Godfrey 1986).

The bald eagle is endangered in Ontario and the lower 48 states of the U.S. While both the bald eagle and the osprey are not endangered in Alberta, they are classified as sensitive and are only sparsely distributed throughout the province (Moore, pers. comm.). The bald eagle and osprey are making a comeback in North America in response to the ban on organochlorine pesticides and intensive management efforts. However, the continued success of both species is dependent upon (1) minimal disturbance at the nest site, and (2) maintaining habitat productivity along the waterbodies and watersheds on which these birds forage.

The rare whooping crane (*Grus americana*), an endangered species in Canada, nests in Wood Buffalo National Park and migrates along the border between Alberta and Saskatchewan. Lone individuals and small groups have been observed to use wetlands in the oil sands area on at least a couple of occasions (Yonge 1978). It is important that the birds remain undisturbed during this period, critical for accumulating body reserves for the remainder of migration.

In September 1990, during a visit to the pelican nesting island in Namur Lake, remains of a large number (>40) of eggs of Caspian Terns that had been destroyed by predators were observed. Caspian Terns have only previously been recorded nesting in Alberta at the west end of Lake Athabasca (Salt and Salt 1976).

7.3.3 Caribou

7.3.3.1 *Status*

Caribou are listed as threatened in Alberta and their numbers are declining (Edmonds 1986). Caribou populations have declined steadily since the early 1900s when they were considered plentiful (Figure 3). However, since the early 1960s the population has declined dramatically. Since then, the caribou population in Alberta has dropped from between 6,860 and 9,060 animals (Stelfox 1966, cited in Edmonds 1986) to less than 2,000 (Edmonds 1986).

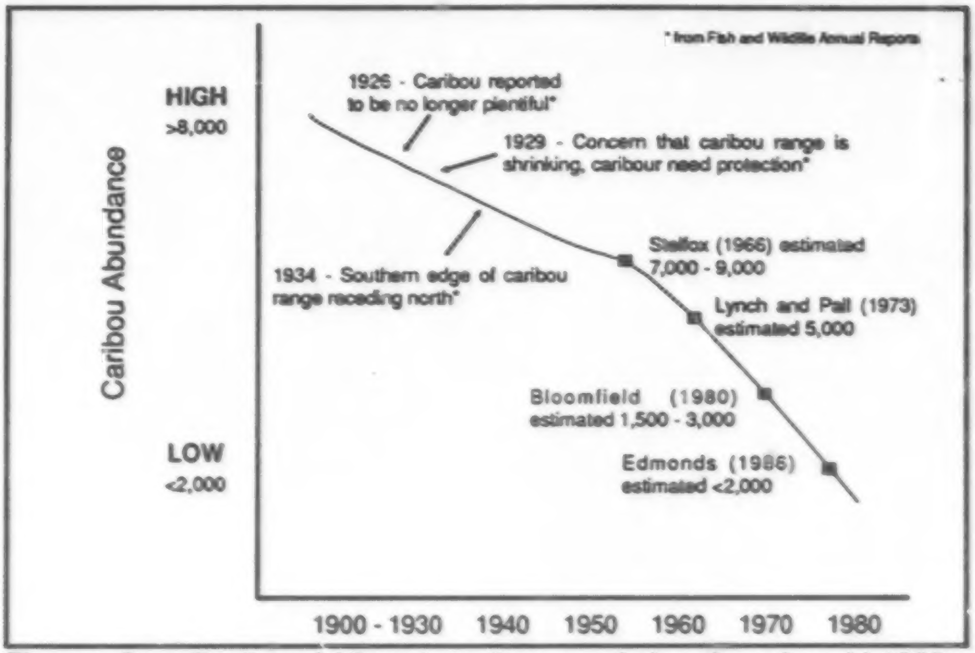


Figure 3. Decline of Alberta's caribou population since the mid-1900s.

At the present time, accurate information on the status of caribou in Alberta is lacking. No systematic inventories have been conducted in the study area in the past. Much of the information that is available has been collected indirectly, often in conjunction with periodic moose surveys and trapper questionnaires and from incidental observations reported by government personnel or other individuals. Based on this limited information base, however, data presented by Edmonds (1986) suggest that approximately 15% (207 to 349 animals) of the provincial caribou population resides within the present study area.

Based on airphoto and Landsat TM image interpretation, eight significant habitat areas were identified for caribou (Table 6). Because of their threatened status in Alberta, all of the sites were rated as provincially significant. Many of these sites include large peatland complexes and scatteredin conjunction with periodic moose surveys and trapper questionnaires and from incidental observations reported by government personnel or other individuals. Based on this limited information base, however, data presented by Edmonds (1986) suggest that approximately 15% (207 to 349 animals) of the provincial caribou population resides within the present study area.

Table 6. Significant woodland caribou habitat in the Eastern Boreal Forest Region of Alberta.

Caribou Area	Site #	Area (km^2)
Birch Mountains	605	3,240
Boivin Creek Peatland	22	220
Christina Lake	608	1,030
Egg Lake - Algar Lake	35	4,810
Iron Point Peatland	458	190
Nipisi Lake	611	200
Parallel Creek Peatland	527	3,580
Salteaux River	612	1,140
Shultz's Bog Diversity Area	8	580
Wiau Lake	607	540

7.3.3.2 Life History

Caribou mature later in life and produce fewer young than other North American cervids. Females generally reach puberty when they are about 28 months old but most do not breed until they are at least three years old and many fail to breed until they are four or older. Bergerud (1983) reported that pregnancy rates for one-year-old females were 0%, for two-year-olds about 15%, for three-year-olds about 53%, and for those four years or older 80 to 90%.

In northeastern Alberta, caribou begin rutting in early September and continue into October (Fuller and Keith 1981). Calves are born from early May to mid-June (Fuller and Keith 1981, Edmonds 1988). Unlike other cervids, which frequently produce twins, female caribou rarely bear more than one calf (Bergerud 1983). Fuller and Keith (1981) reported that in the Birch Mountains of northeastern Alberta, the calf:adult ratio at birth was 41:100 but that this ratio had dropped to 13:100 by February. This was a result of extremely low calf survival. Based on these data, they calculated that only 25% of calves survived to the end of their first year; however, causes for this high level of calf mortality could not be determined (Fuller and Keith 1981). Compared to other areas of North America, both calf and adult mortality (15%) were high in the Birch Mountains. Recruitment (14%) and adult mortality rates led Fuller and Keith (1981) to believe that the Birch Mountain population was declining.

Woodland caribou in Alberta often undertake seasonal movements but these are small compared to the spectacular migrations of barren-ground caribou. Edmonds (1988) reported that most woodland caribou in west-central Alberta moved less than 5 km between seasonal ranges, although some movements were greater than 15 km. Longer seasonal movements were reported in the Birch Mountains where movements of cows and bulls were from 17 to 20 km and from 23 to 48 km, respectively (Fuller and Keith 1981). Seasonal movements of caribou appeared to be associated with breeding and natal activity, and seasonal variation in diet (Fuller and Keith 1981, Darby and Pruitt 1984).

7.3.3.3 Habitat Use

Woodland caribou in the Birch Mountains prefer lowland habitats for much of the year. Fuller and Keith (1981) reported that black spruce muskeg, which contained 44% of caribou locations, was the most heavily-used habitat at all times of the year, whereas aspen forest and mixedwood forest containing aspen were seldom used. In their study area, the use of lowland habitats by caribou increased in early spring, apparently in response to the emergence of vascular vegetation. As spring and summer progressed, caribou tended to move into pine and spruce-dominated upland forest to take advantage of the increasing abundance of vascular vegetation in those habitats. However, the use of upland forest decreased after the rut when many caribou aggregated on open lowlands. Fuller and Keith (1981) postulated that during this period, security was provided by group membership rather than forest cover. As winter progressed and snow depth in lowland habitats increased, the use of upland forests increased, probably in response to lower snow accumulations in these habitat types, which made it easier to crater for terrestrial lichens.

Similar seasonal variation in habitat use has been described for woodland caribou in Manitoba (Darby and Pruitt 1984). Like caribou in Alberta, those in Manitoba tended to aggregate near bogs during and after the rut. During this period, they fed primarily on lichens and ericaceous shrubs. Use of bogs continued until February when deep, hard snow restricted travel and access to forage, and caribou moved into jack pine forest where snow was shallower and softer. These snow conditions allowed caribou to feed more easily on lichens, although they also foraged on woody browse provided by willow and alder.

Lichens, which are eaten throughout the year (see review by Thompson et al. 1980), provide the bulk of the caribou diet. In west-central Alberta, 66% of the winter diet (Edmonds and Bloomfield 1988) and about 20% of the summer diet of caribou is provided by lichens (Edmonds, pers. comm.).

7.3.3.4 Management Considerations

Important considerations for caribou management in northeastern Alberta include the loss, degradation, and fragmentation of important caribou range; the direct loss of animals through overhunting, poaching, and increased levels of predation; and a general lack of information about the ecology of caribou over most of northeastern Alberta.

Edmonds (1986) reported that caribou in west-central Alberta suffered two dramatic declines between the 1930s and 1970s. From the 1930s to 1950, the population dropped from more than 2,000 animals to less than 300 as a result of two severe winters; high wolf density; and intensive, small-scale logging. The population recovered to about 1500 animals in the early 1960s but again declined to less than 300 animals in response to rapidly expanding industrial development, and increased hunting and predation pressure.

From studies conducted in the Birch Mountains (Fuller and Keith 1981), it appears that caribou have unique habitat requirements that often vary seasonally. Caribou in that area prefer bogs, particularly those dominated by black spruce, for much of the year. However, caribou distribution may be limited by the distribution and extent of coniferous forests of sufficient age to produce lichens for winter forage. Miller (1976) reported that such forests are at least 30 to 40 years old; however, in

Alberta good lichen-producing forests are typically 60 to 80 years old (Edmonds pers. comm.). Although both arboreal and terrestrial lichens are consumed, in most forests the biomass of arboreal lichens is much lower than that of terrestrial lichens. Thus, the distribution of caribou in northeastern Alberta appears to be largely determined by the availability of lichen-producing forests. Therefore, large areas of heterogenous habitat, which include both lowlands and extensive tracts of lichen-producing forest, must be maintained. This will allow caribou to harvest lichens, which regenerate very slowly, on a sustained-yield basis.

Increased human activity and the establishment of roads, cutlines, and cutblocks have the potential to substantially reduce caribou populations in northeastern Alberta. Bergerud (1974) reported that there was a fine balance between levels of reproduction and natural mortality for caribou. Thus, increased human activity, access, hunting pressure, or predation may cause caribou numbers to decline.

Caribou are more susceptible to overhunting than any other North American cervid because they often form large groups in open areas and seem unable to perceive danger at a distance (Bergerud 1974). Moreover, when hunted, they frequently become confused and mill about, which allows them to be easily shot (Lynch and Pall 1973). Edmonds (1988) reported that caribou were frequently poached or killed by accident in west-central Alberta during a fall hunting season which was closed for caribou. Poaching was also a problem during the rest of the year; of the 31 caribou found dead during her study, 55% were illegally shot, 23% were struck by vehicles, and 3% were killed by wolves. Eighty-three percent of the dead animals were found within 50 m of a road, suggesting that roads and access contributed to caribou mortality in that area. Bergerud and Mercer (1989) also indicated that poaching seriously affected caribou numbers; they reported that a group of six caribou released in Newfoundland were extirpated by illegal hunting.

Caribou numbers may also decline as a result of increased predation after areas are opened by roads and logging (Bergerud 1974). Caribou use of large tracts of mature coniferous forest appears to be, at least partly, a strategy to avoid predation. Caribou, which are less able to defend themselves against predators than other species of cervid (Edmonds, pers. comm.), can greatly reduce the probability of encountering foraging predators such as wolves by scattering widely within such habitats. Seip (1990) reported that in winter, caribou were separated from wolves both spatially and by differential habitat use, whereas moose and wolves generally occurred together. Land use activities such as logging often enhance forage production for deer and moose. If forage production has been limiting, deer and moose populations may expand in response to increased browse availability. Consequently, the increased prey base may allow predators, such as wolves, to multiply, and upset the balance between caribou reproduction and natural mortality. Populations of black bear, which also are an important predator of caribou calves (Edmonds pers. comm.), are also likely to expand in response to the creation of early successional habitats.

The establishment of corridors, such as cutlines, may also prove detrimental to caribou. Wolves frequently use cutlines and roads as travel corridors. If such corridors traverse important caribou habitat, large predators, such as wolves, will be able to more effectively search large blocks of habitat to prey on caribou.

A further concern is the lack of specific information about the ecology and habitat requirements of caribou in northeastern Alberta. Only one caribou study, which was conducted between 1976 and 1978, has been done in that area (Fuller and Keith 1981). This study concentrated primarily on seasonal movements and habitat use by woodland caribou in the Birch Mountains. Fuller and Keith concluded, however, that their study may have dealt with an "ecologically distinct subspecies". Thompson et al. (1980) conducted an extensive literature review to assess the status of information on caribou as it related to oil sands development in the AOSERP area. They cited no studies conducted in either the present study area or the AOSERP area except for that of Fuller and Keith (1981) which was then in progress. Therefore, the condition of caribou populations and their range ecology over most of the study area is unknown.

Preservation of this species in Alberta dictates that information be gathered about population densities and trends, and seasonal movements and habitat use of caribou on ranges in northeastern Alberta. This information should also be used to determine if caribou in northeastern Alberta represent a single population or a number of genetically-isolated subpopulations. Seasonal forage requirements, as well as forage production and use should also be examined to quantify the importance and carrying capacity of various segments of caribou range.

7.3.4 Moose

7.3.4.1 Status

Throughout most of northeastern Alberta, the moose is the most economically important ungulate species. Moose are the focus of most of the recreational and subsistence hunting conducted in the region and have historically comprised an important component of traditional resource use and native culture. Although woodland caribou are currently the species of greatest scientific interest and concern, the low numbers and protected status of that species make it much less important than moose as a source of food or recreation to the people of the region. Similarly, because of the low density of mule deer and discontinuous distribution of white-tailed deer throughout much of the region, the overall importance of these species is low compared to moose.

Current information on the status of the moose over much of the study region is lacking. Traditionally, winter aerial surveys have served as the primary source of information on abundance, distribution, and productivity of moose. However, costs of obtaining these types of management data are very high, and continuing government restraint has forced the Alberta Fish and Wildlife Division to reduce aerial survey efforts and to rely on less precise sources of information such as hunter success rates and trapper questionnaires. A review of aerial survey records maintained by the Division indicates that many parts of northeastern Alberta have never been censused and that much of the survey data that have been obtained are now outdated. All of the aerial surveys conducted over the past ten years together cover less than 15% of the study area.

The available data show that, although moose are widely distributed throughout the region, densities at a regional level have historically been low, averaging 0.2-0.4 moose per km^2. These densities are much lower than those that have historically occurred in certain other parts of the province such as the Swan Hills and many parts of the eastern slopes.

7.3.4.2 Key Habitats and Life History

The few survey data that are available for northeastern Alberta show that moose are not evenly distributed throughout the region, particularly in late winter when this species congregates in areas of preferred habitat. The importance of major river valleys as wintering areas for moose in northeastern Alberta has long been recognized, with aerial surveys repeatedly showing concentrations of moose along the Athabasca and Clearwater Rivers as well as along portions of the Christina, Wabasca, MacKay and other large rivers (Photos 7 and 8). Radiotelemetry studies conducted in the AOSERP study area have shown that moose in northeastern Alberta commonly undertake extensive seasonal movements from higher elevation summer ranges to wintering areas along the Athabasca River (Hauge and Keith 1981).

Available survey information also indicates that certain other topographic features may be regionally significant for moose. Moose frequently are recorded in comparatively high numbers along the slopes and near the base of major uplands such as the Birch Mountains and Stony Mountain. This appears to be habitat related, as these landforms typically support extensive tracts of deciduous forest, which many studies have shown to be the preferred habitat of moose in Alberta (Nowlin 1978, Hauge and Keith 1981, Mytton and Keith 1981). Groundwater discharge areas located in lower slope positions around the base of these uplands support high densities of willow, the preferred browse species for moose in the province (Westworth et al. 1983).

Based on a review of available survey information, conversations with Fish and Wildlife Division biologists, and airphoto interpretation, 23 areas were identified within the Eastern Boreal Forest Region that appear to be significant for moose

Photos 7 and 8. The valleys of the Athabasca River - Rapids Reach (top) and the Wabasca River - Canyon Reach (bottom) provide critical winter range for moose and serve as important biological corridors for a variety of fish and wildlife species.

(Table 7). These include major river valley wintering areas, and high quality upland habitats known to support the highest densities of moose in the region.

Table 7. Significant moose habitat areas in the Eastern Boreal Forest Region of Alberta.

Moose Area	Site #	Significance	Area (km^2)
Athabasca River - Pembina Reach	487	National	740
Athabasca River - Rapids Reach	531	National	940
Athabasca River - Tar Sands Reach	532	National	410
Calumet Plains	555	Regional	660
Christina River (Lower Reach)	158	Provincial	170
Christina Uplands	216	Regional	2,550
Clearwater River	45	Provincial	480
Dover - McKay River	609	Regional	160
Firebag River	31	Provincial	70
Fort Hills	497	Regional	160
Horse River	98	Regional	90
House River Meltwater Channel	93	Regional	230
Kearl Lake	39	Regional	230
McMillan Lake	529	Regional	100
McKay River	113	Regional	170
Muskwa River	147	Regional	80
Owl River Diversity Area	11	Regional	170
Peavine Prairie Diversity Area	30	Regional	140
Pelican Mountains Escarpment	526	Regional	460
September Lake	610	Regional	430
Trout Mountain	569	Regional	120
Wabasca River - Canyon Reach	534	Provincial	210
Wabasca River - Upper Reach	129	Provincial	270

7.3.4.3 Factors Controlling Moose Populations in Northeastern Alberta

Reasons for the low densities of moose throughout most of the study region are not clear, since little research has been conducted on the dynamics and regulation of moose populations in this part of it's range. Peek and Eastman (1983) hypothesized that moose populations in North America have evolved reproductive strategies that are flexible, reflecting the dynamic, unstable nature of their environment. Historically this environment was characterized by frequent wildfires that resulted in large changes in the availability of food. They suggest that moose populations increase during periods of increased forage availability and decline due to the combined effect of a number of factors including predation, disease, weather-snow conditions and intraspecific competition for forage. In Alaska, Schwartz and Franzmann (1989) concluded that predation and habitat quality operated in concert to control moose populations, with mortality by either of these agents acting in a compensatory or noncompensatory manner depending on habitat quality, predator density, or the severity of winter weather. They observed higher reproductive performance and increased survival rates on high quality range, whereas populations remained low in areas of poor habitat, partly a result of the effects of severe winters which resulted in high calf mortality due to malnutrition.

In one of the few detailed studies of the population dynamics of moose in northeastern Alberta, wolf predation was shown to be a principal mortality factor, annually accounting for 13-17% of the moose population. Periodic outbreaks of the tick (*Dermacentor albipictus*) are also thought to have contributed to population declines by moose in Alberta (Samuel and Barker 1979, Rippen, pers comm). The relationship between habitat quality, predation and other mortality factors in northeastern Alberta has not been studied. Looking at the situation from a regional perspective, the unavoidable conclusion is that moose habitat quality is highly discontinuous over the region and that much of the region is dominated by habitats of comparatively low quality. Examination of Landsat TM imagery shows that suitable deciduous habitats are often limited to strips of habitat along major rivers or "islands" of habitat associated with plateaus or ranges of hills, surrounded by expansive areas of bogs, peatlands and black spruce forests.

These isolated areas of good habitat may play a significant role in the regulation of moose populations over the entire region. As indicated above, moose populations tend to remain low in areas of low quality habitat because of lower reproductive performance and reduced survival. In areas where levels of human exploitation or wolf predation are high, maintenance of moose populations may be dependant on dispersal of surplus animals from areas of good habitat. Some of the research previously conducted in Alberta appears to support this hypothesis.

The density of moose in the study area appears to approximate the minimum required to produce surplus animals in an unhunted, increasing population, as indicated by data presented in Rolley and Keith (1980). Thus, any activity that destroys favourable habitat or greatly increases mortality rates may cause a serious decline in the moose population in northeastern Alberta. Another concern is that moose, which do not readily disperse into adjacent areas, may take much time to repopulate locales in which their numbers have been substantially reduced by human activity (Lynch pers. comm.). Data collected near Rochester, Alberta (Rolley and Keith 1980) indicate that only about 8% of the resident moose dispersed each year after the population reached 0.7 moose km^2. This suggests that the repopulation of depopulated areas will proceed very slowly because of low population densities in the study area.

7.3.4.4 Management Considerations

The relationship of moose to logging, oil and gas, and other forms of resource development in Alberta is not clear. Logging, like forest fires, creates the early seral communities generally thought to exemplify high quality moose habitat. Pronounced increases in browse production have been documented on aspen clearcuts within three years following logging (Brusnyk and Westworth 1988). Brusnyk and Westworth (1985) also documented significant increases in browse production and use of pipeline corridors by moose in Alberta. The extent to which these increases in carrying capacity are reflected in population increases, however, appears to depend on a number of other factors, particularly the degree to which the development contributes to increased access and hunting pressure.

Increased access in the form of roads and cutlines usually increases hunting pressure because it facilitates access to remote areas by all-terrain-vehicles. Lynch (1973) reported that hunters that used all-terrain-vehicles were much more successful than those who did not. Moreover, most recreational hunters prefer to hunt near roads. Near Swan Hills, Alberta, 80% of the hunting occurred within the 18%

of the area which was within 1.5 km of a roads. Similarly, Bergerud et al. (1968) found that in Newfoundland, hunters travelled a maximum of 925 m from a road to shoot moose.

The Alberta Fish and Wildlife Division is conducting a long-term study to evaluate the effects of aspen harvesting on ungulate populations in the Shiningbank area of west-central Alberta. The study showed that, although increased browse production on the clearcuts greatly increased the carrying capacity of the area for moose, use of the clearcuts by moose was restricted by increased hunting activity and human harassment resulting from the network of roads and trails created through the area (Brusnyk and Westworth 1988). Other studies have shown that logging activities correlate with population increases by moose in areas where moose are unexploited (Peek et al.1976) but that they may result in lower populations due to overhunting in other areas (Eason et al. 1981). In Ontario, three separate studies which examined the impact of access created by timber harvesting on moose all concluded that access provided by logging roads was important in the decline of the herd (Eason et al. 1982, Timmerman and Gollat 1983, Flemming and Koski 1976 cited by Thompson and Euler 1987).

On the surface, the problem is simply a matter of managing the resource to prevent over-exploitation. The Fish and Wildlife Division uses a number of methods to control hunting pressure on moose including shortened seasons, restricted licensing (authorizations), road closures, restrictions in the use of all-terrain-vehicles and increased surveillance against poaching. In Alberta, as it is in certain other parts of the country, the wild card is subsistence hunting. As an aboriginal right provided under the Natural Resources Transfer Agreement in 1930, Treaty Indians area allowed to hunt on unoccupied Crown Land for their own personal use in Alberta. Areas exposed to heavy, year around, subsistence hunting pressure are vulnerable to over-exploitation. The increased access that results from resource development inevitably contributes to this problem.

There is a clear need to develop effective solutions to the problem of increased access within key habitat areas. Government, industry and native groups must work together to develop realistic management plans for these areas that will ensure that development will be carried out in a manner that maintains the viability of moose populations in the region. As mentioned above, we feel that moose populations in central and northern parts of the study area may be particularly vulnerable to these types of impacts because of the discontinuous nature of good quality moose habitat in these areas. If future development leads to population declines within the isolated areas of good habitat, thereby reducing dispersal rates into adjacent lower quality habitats, a general population decline could be experienced throughout the region.

7.3.5 Furbearers

At least 4 species of furbearing mammals may be sensitive to development in northeastern Alberta. These include the river otter, lynx, marten, and wolverine. However, there is little information about the distribution of most furbearers in Alberta and population densities and habitat preferences for many species are largely unknown.

In the present study, fur harvest records, which are compiled annually by the Alberta Fish and Wildlife Division and remain almost the only source of information about furbearer abundance in the province, were used to identify important areas for these furbearer species. However, fur harvest records may not provide an accurate indication of furbearer abundance because they are affected by a number of biological and socio-economic factors other than population density. Such factors include fur prices, furbearer diversity, and trapper tradition. In this study, areas were identified as important furbearer habitat if the capture of a specific furbearer on two or more adjacent registered trapping areas was notably higher than for most other trapping areas in the region. The analysis resulted in the identification of 13 significant habitat areas for furbearers (Table 8).

7.3.5.1 River Otter

The river otter occurs at low densities in areas of suitable habitat throughout much of Alberta but is much more abundant in northeastern Alberta than elsewhere in the province (Boyd 1977, Skinner and Todd 1988). An analysis of 1970 to 1975 fur returns indicated that northeastern Alberta was the only portion of the province in which trappers captured more than one otter per 1000 km^2 (Boyd 1977). In comparison, the maximum catch for the remainder of the province was less than 0.5 otter per 1000 km^2. Within the present study area, the otter is particularly abundant in an area which includes the Winefred Lake-Grist Lake Watershed (Table 8). This area extends northwest into the Conklin area (Hogarth, pers. comm.) and therefore includes much of the Christina Lake Caribou Area. On the basis of fur harvest data, Boyd (1977) similarly indicated that the density of otter in the Winefred Lake area was much higher than elsewhere in the province. His analysis of trapping returns suggested that the density of otter in that vicinity was almost 20 times the provincial average (4 vs. 0.2 otter trapped per 1000 km^2).

Table 8. Significant natural sites in the Eastern Boreal Forest Region of Alberta that contain important concentrations of furbearing mammals.

Area	Site #	Significance	Otter	Lynx	Marten
Algar Lake Sandhills	21	Regional		✓	
Athabasca River - Rapids Reach	531	National		✓	
Birch Mountains Caribou Area	605	Provincial		✓	✓
Birch Mountains Escarpment	554	Regional		✓	
Calumet Plains	555	Regional		✓	
Christina Lake Caribou Area	608	Provincial	✓		
Firebag Marten Area	606	Regional			✓
Fort Hills	497	Regional		✓	
Gordon Lake Diversity Area	545	Regional		✓	
Horse River Diversity Area	538	Regional		✓	
Shultz's Bog Diversity Area	8	Regional		✓	
Thickwood Hills	550	Regional		✓	
Winefred Lake - Grist Watershed	593	Provincial	✓		

7.3.5.2 Lynx

The lynx is an obligate predator of the snowshoe hare, which comprises 75 to 95% of the its diet during periods of hare abundance (van Zyll de Jong 1966, Brand et al. 1976, Parker 1981). As a result, the lynx undergoes a 3 to 5-fold population fluctuation in response to the "10 year" snowshoe hare cycle (Brand et al. 1976, Brand and Keith 1979); however, the lynx cycle lags that of the snowshoe hare by approximately 2 years. These cyclic changes in lynx abundance and its extreme dependence on a single prey species make it susceptible to overtrapping during the low phase of its population cycle (Brand and Keith 1979, Carbyn and Patriquin 1983). In recent years, high fur prices have resulted in intensive trapping pressure on lynx, which when superimposed on a normal cyclic low in the mid-1980s, appears to have severely depressed the lynx population in Alberta. Skinner and Todd (1988) reported that, despite high fur prices, the lynx harvest during the population low of 1985-86 was only 44% of that during the previous low in 1975-76. Some biologists feel that areas which support relatively high numbers of lynx during cyclic lows represent refugia from which dispersal occurs during the increase and peak phases of the cycle. Such areas therefore, require careful management.

In the present study, four such areas were identified from fur harvest records (Table 8). These include the Gordon Lake Diversity Area; the Fort Hills; an area southeast of Sand Lakes; and a large area adjacent to the Rapids Reach of the Athabasca River, located upstream from Fort McMurray. The Sand Lake area includes portions of the Birch Mountains Diversity Area south of Eaglenest Lake and east of Sand Lake, the northeastern one-half of the Birch Mountains Escarpment, and the portion of the Calumet Plains north of Joslyn Creek. Lynx habitat along the Athabasca River includes the reach downstream of the confluence of the House River to Fort McMurray, the Thickwood Hills, Horse River Diversity Area, Algar Lake Sand Hills, and the eastern one-half of Schultz's Bog Diversity Area (Table 8). All of the areas identified as important for lynx in this study contain a diversity of habitats and most include lowland coniferous forest interspersed with stream channels and wetlands which support dense stands of willow. These areas provide both cover and forage for the snowshoe hare and appear capable of supporting populations of snowshoe hares and lynx during cyclic lows.

7.3.5.3 Marten

Historically, the marten population within the present study area has been low; as late as the mid-1970s the species was reported to be "rare to nonexistent" in forested portions of northeastern Alberta (Todd and Geisbrecht 1979). However, in recent years the population has increased in that area (Neumann, pers. comm.). Despite their expanding population, marten require careful management because they are easily captured and therefore susceptible to overtrapping (Todd and Geisbrecht 1979, Stordeur 1986). Moreover, this species is more habitat dependent than most other carnivores. Marten habitat requirements include late-successional and climax old-growth coniferous or coniferous-dominated mixedwood forest, which provide both denning sites and access, via fallen trees, to prey in the subnivian environment (More 1978, Slough 1989). Conversely, even small clearings are usually avoided (Hawley and Newby 1957, Koehler and Hornocker 1977). In contrast, most other predators will occupy a variety of habitat types if prey is sufficiently abundant.

Based on 1988-89 fur harvest records, two areas along the northern boundary of the study area appear to provide important habitat for marten (Table 8). These areas include the Birch Mountains Caribou Area, which appears to be dominated by mature spruce forests, and the Firebag Marten Area, in which the forest cover consists primarily of stands of jack pine and spruce.

7.3.5.4 Wolverine

The wolverine is the rarest furbearer in Alberta and population densities of this species within the province are unknown (Todd and Geisbrecht 1979). Van Zyll de Jong (1975) similarly noted that, where the wolverine occurs, it is much less common than other species of similar-sized carnivores. Because of its scarcity, the wolverine has seldom been studied in any area and its population dynamics and habitat preferences are therefore largely unknown. However, a few studies have indicated that the wolverine appears to be associated with coniferous-dominated forest in areas that support large populations of ungulates, which provide critical winter food in the form of carrion (van Zyll de Jong 1975, Hornocker and Hash

1981). The number of wolverine taken by trappers in Alberta is extremely low; only 42 were trapped in northeastern Alberta during the five years between 1984-85 and 1988-89. These low harvest rates preclude the identification of important areas for the wolverine from fur harvest records. Because of the wolverine's sparse distribution and preference for inaccessible areas, human activities and increased access associated with development have the potential to eliminate the species from much of its range in northeastern Alberta.

7.4 Fisheries and Aquatic Resources

7.4.1 Status

Significant natural sites for fish were chosen to reflect the outstanding fish habitat capabilities based on a 30 year average from the region (Table 9). Unlike other environmentally significant features, significant areas for fish cannot fully be described by mapped polygons surrounding aquatic features. Fish habitat is affected by all aspects of the aquatic and terrestrial environment within the boundaries of the contributing watershed sub-basin.

Fish habitat in the study area is supplied by three of Alberta's principal drainages. The northwest part of the region is drained north towards the Peace River basin by the Wabasca River and its associated tributaries. In the southwest, central, and northeast portions of the study area, lakes and tributaries of the Athabasca River drain northeast to meet the Peace River drainage in the vicinity of the Peace-Athabasca delta. In the southeast, Hudson Bay drainage is facilitated by the Cold Lake-Beaver River basin the Wabasca River and its associated tributaries. In the southwest, central, and northeast portions of the study area, lakes and tributaries of the Athabasca River drain northeast to meet the Peace River drainage in the vicinity of the Peace-Athabasca delta. In the southeast, Hudson Bay drainage is facilitated by the Cold Lake-Beaver River basin.

These drainages collectively support one of Alberta's most diverse and economically important domestic, commercial, and recreational fisheries. In 1979, Paetz (1979) estimated that 700 000 kg of fish were taken annually by the domestic harvest

Table 9. Significant fish habitats in the Eastern Boreal Forest Region.

Waterbody/Watercourse	Site #	Significance Level	Important Fish Species[1]										
			LKTR	WALL	LKWT	CISC	GRAY	MNWT	PIKE	YWPH	RBTR	GOLD	BURB
Athabasca River:													
Pembina Reach	487	National		✓			✓	✓	✓		✓	✓	✓
Rapids Reach	531	National		✓	✓		✓	✓	✓			✓	
Tar Sands Reach	532	National		✓	✓		✓		✓			✓	
Base Lake and Creek	080	Regional			✓				✓				✓
Behan Lake	208	Regional		✓					✓	✓			
Big Island Lake	557	Provincial		✓	✓				✓	✓			
Brintnell Lake	587	Regional		✓	✓	✓			✓	✓			
Burnt Lakes	010	Regional			✓				✓				
Calling Lake	149	Provincial		✓	✓	✓			✓	✓			✓
Calling River	148	Regional		✓			✓		✓				
Chipewyan Lake	165	Regional			✓				✓				
Christina Lake/Jackfish R.	078	Regional		✓	✓	✓	✓		✓	✓			✓
Christina River:													
Lower Reach	158	Provincial		✓	✓		✓	✓	✓	✓		✓	✓
Middle Reach	217	Regional		✓	✓		✓	✓	✓			✓	✓
Upper Reach	218	Regional		✓	✓		✓	✓	✓			✓	✓
Clarke Creek	043	Regional					✓						
Clearwater River	045	Provincial		✓	✓		✓	✓	✓			✓	✓
Clyde Lake	205	Regional				✓			✓				
Cowper Lake	088	Regional							✓	✓			
Dover River	118	Regional							✓	✓			
Driftwood Lake	582	Regional							✓	✓			
Edwards Lake	564	Regional			✓				✓				✓
Ells River	018	Provincial		✓	✓		✓	✓	✓	✓		✓	✓

[1] LKTR - Lake Trout; WALL - Walleye; LKWT - Lake Whitefish; CISC - Cisco; GRAY - Arctic Grayling; MNWT - Mountain Whitefish; PIKE - Northern Pike; YWPH - Yellow Perch; RBTR - Rainbow; Trout; GOLD - Goldeye; BURB - Burbot

Table 9. Continued.....

Waterbody/Watercourse	Site #	Significance Level	Important Fish Species[1]										
			LKTR	WALL	LKWT	CISC	GRAY	MNWT	PIKE	YWPH	RBTR	GOLD	BURB
Equisetum Lake	541	Regional		✓	✓	✓			✓				✓
Firebag River	031	Provincial		✓	✓		✓		✓	✓			✓
Francis Lake	212	Regional							✓	✓			
Gardiner Lakes	017	Regional		✓	✓				✓	✓			
Garson Lake	546	Regional			✓				✓	✓			
Georges Lake	067	Regional		✓		✓			✓	✓			
Gipsy Lake	057	Regional			✓				✓				
Glover Lake	580	Regional			✓				✓				✓
Gods Lake	586	Provincial		✓	✓				✓				
Goodfish Lake	187	Regional		✓	✓				✓	✓			
Graham Lake	183	Regional		✓	✓	✓			✓				✓
Gregoire Lake	065	Regional		✓	✓	✓			✓	✓			✓
Gregoire River	064	Regional		✓			✓		✓				
Grist Lake	091	Provincial	✓		✓	✓	✓		✓				✓
Hangingstone River	096	Regional		✓			✓	✓	✓				
Hartley Creek	037	Regional					✓	✓	✓				
Heart Lake	211	Provincial		✓	✓	✓			✓	✓			✓
High Hill River	049	Provincial					✓	✓	✓				
Horse River	098	Regional		✓			✓		✓	✓		✓	
Horseshoe Lake	585	Regional									✓		
House Creek	159	Regional					✓						
House River-Upper Reach	464	Regional		✓			✓	✓	✓				
House River Meltwater Ch.	093	Regional		✓			✓	✓	✓				
Jackson Lake	571	Regional		✓		✓			✓	✓			✓
Jumbo Lake	581	Regional			✓				✓				

[1] LKTR - Lake Trout; WALL - Walleye; LKWT - Lake Whitefish; CISC - Cisco; GRAY - Arctic Grayling; MNWT - Mountain Whitefish; PIKE - Northern Pike; YWPH - Yellow Perch; RBTR - Rainbow; Trout; GOLD - Goldeye; BURB - Burbot

Table 9. Continued....

Waterbody/Watercourse	Site #	Significance Level	Important Fish Species [1]										
			LKTR	WALL	LKWT	CISC	GRAY	MNWT	PIKE	YWPH	RBTR	GOLD	BURB
Kettle River	071	Regional					✓						
Kinnaird Lake	572	Regional		✓		✓			✓	✓			✓
Kirby Lake	077	Regional		✓	✓				✓				✓
La Biche River	533	Regional		✓					✓				
Lakeland Diversity Area	012	Provincial		✓	✓	✓			✓	✓			✓
Landels River	401	Regional					✓						
Lawrence Lake	220	Regional							✓	✓			
Legend Lake	157	Regional			✓	✓			✓				✓
Lesser Slave River	489	Regional		✓	✓	✓	✓	✓	✓	✓		✓	✓
Liege River	020	Regional					✓						
Logan Lake	210	Regional		✓		✓			✓	✓			
Logan River	202	Regional		✓					✓				
Long Lake	023	Regional		✓	✓				✓				
Long Lake	583	Regional		✓	✓				✓				
MacKay River	113	Regional		✓			✓	✓	✓	✓			✓
Marguerite River	032	Regional					✓	✓	✓				✓
May River	069	Regional					✓		✓				
McGuffin Lake	577	Regional		✓		✓			✓	✓			
McLeod Lake	139	Regional			✓				✓				
McMillan Lake (West)	144	Regional			✓	✓			✓	✓			
Meyer Lake/ Chain Lakes	490	Regional							✓	✓	✓		
Mistehae Lake	575	Regional		✓	✓	✓			✓	✓			
Muskeg River (North)	034	Regional		✓	✓		✓	✓	✓				✓
Muskwa Lake	146	Regional		✓	✓	✓			✓	✓			✓
Namur Lake	007	Provincial	✓		✓	✓	✓		✓				

[1] LKTR - Lake Trout; WALL - Walleye; LKWT - Lake Whitefish; CISC - Cisco; GRAY - Arctic Grayling; MNWT - Mountain Whitefish; PIKE - Northern Pike; YWPH - Yellow Perch; RBTR - Rainbow; Trout; GOLD - Goldeye; BURB - Burbot

Table 9. Continued....

Waterbody/Watercourse	Site #	Significance Level	Important Fish Species[1]										
			LKTR	WALL	LKWT	CISC	GRAY	MNWT	PIKE	YWPH	RBTR	GOLD	BURB
Namur River	120	Regional			✓		✓		✓				✓
Namur/Gardiner Watershed	592	Provincial	✓	✓	✓	✓	✓	✓	✓	✓		✓	✓
Nipisi Lake	152	Regional		✓	✓	✓			✓	✓			✓
North Wabasca Lake	132	Provincial		✓	✓	✓			✓	✓			✓
Owl River	201	Regional		✓					✓				
Peerless Lake	184	Provincial	✓	✓	✓	✓			✓	✓			✓
Peerless/Graham Watershed	594	Provincial	✓	✓	✓	✓			✓	✓			✓
Pembina River	230	Regional		✓			✓	✓	✓		✓	✓	✓
Piche Lake	213	Regional		✓	✓	✓			✓	✓			✓
Piche River	598	Regional		✓					✓				
Pierre River	038	Regional		✓			✓		✓				
Rock Island Lake	150	Regional		✓	✓	✓			✓				✓
Round Lake	232	Regional		✓	✓	✓			✓	✓			✓
Rourke Creek	219	Regional			✓		✓		✓				
Royemma Lake	590	Regional			✓				✓				
Saline Creek	063	Regional					✓						
Salteaux River	505	Regional					✓		✓				
Sand Lake	015	Regional		✓	✓				✓	✓			
Sander Lake	140	Regional			✓				✓	✓			
Sandy Lake	135	Regional		✓	✓	✓			✓	✓			✓
Saprae Creek	062	Regional					✓						
Seibert Lake	579	Provincial		✓	✓	✓			✓	✓			✓
South Wabasca Lake	133	Provincial		✓	✓	✓			✓	✓			✓
Spencer Lake	578	Regional		✓	✓				✓	✓			✓
Square Lake	561	Regional				✓			✓	✓			✓

[1] LKTR - Lake Trout; WALL - Walleye; LKWT - Lake Whitefish; CISC - Cisco; GRAY - Arctic Grayling; MNWT - Mountain Whitefish; PIKE - Northern Pike; YWPH - Yellow Perch; RBTR - Rainbow; Trout; GOLD - Goldeye; BURB - Burbot

Table 9. Continued....

Waterbody/Watercourse	Site #	Significance Level	Important Fish Species [1]										
			LKTR	WALL	LKWT	CISC	GRAY	MNWT	PIKE	YWPH	RBTR	GOLD	BURB
Steepbank River	040	Regional		✓	✓		✓		✓				
Surmont Creek	081	Regional					✓						
Touchwood Lake	570	Provincial	✓	✓	✓	✓			✓	✓			✓
Unnamed Lake	589	Regional		✓	✓	✓			✓				
Unnamed (18 Mile) Lake	563	Regional									✓		
Unnamed (Kimowin) Lake	565	Regional							✓	✓			
Unnamed (Sand) River	595	Regional		✓			✓		✓				
Unnamed (Twin) Lake	562	Regional							✓	✓	✓		
Unnamed Lake	566	Regional		✓	✓	✓			✓	✓			✓
Unnamed Lake	591	Regional							✓	✓			
Vandersteene Lake	185	Regional		✓	✓	✓			✓	✓			✓
Wabasca River (Canyon)	534	Provincial		✓			✓		✓			✓	
Wabasca River (Upper)	129	Provincial		✓			✓		✓			✓	
Wandering River	198	Regional		✓			✓		✓				
Watchusk Lake	083	Regional							✓	✓			
West Twin Lake	584	Regional			✓				✓				
Winefred Lake	090	Provincial		✓	✓	✓			✓	✓			✓
Winefred River	082	Regional		✓			✓		✓	✓			
Winefred/Grist WS	593	Provincial	✓	✓	✓	✓	✓		✓	✓			✓

[1] LKTR - Lake Trout; WALL - Walleye; LKWT - Lake Whitefish; CISC - Cisco; GRAY - Arctic Grayling; MNWT - Mountain Whitefish; PIKE - Northern Pike; YWPH - Yellow Perch; RBTR - Rainbow; Trout; GOLD - Goldeye; BURB - Burbot

in Alberta. Lakes of the Eastern Boreal Forest Region likely contributed 25-50 % of this provincial total. Similarly, 70 of the 226 lakes that are commercially harvested in Alberta exist within the study region. These 70 lakes account for at least 20 % of the approximately 3.0 million kg of fish harvested annually in Alberta (Alberta Recreation, Parks and Wildlife 1976, Alberta Fish and Wildlife file data). In terms of its recreational fisheries value, the study area overlaps Alberta Fish and Wildlife's northeastern jurisdiction which accounts for the largest proportion of angler days (36.8%) expended in the province (Department of Fisheries and Oceans, 1988). Sportfishing is considerably less popular among residents of the adjacent Athabasca and Peace River jurisdictions; however, non-resident anglers in these two regions contribute significantly to the provincial total (Department of Fisheries and Oceans, 1988). Economically important coldwater species include Arctic grayling (*Thymallus arcticus*), lake trout (*Salvelinus namaycush*), lake whitefish (*Coregonus clupeaformis*), cisco (*Coregonus artedii*), and mountain whitefish (*Prosopium williamsoni*). Rainbow trout (*Onchorynchus mykiss*) are also present where suitable conditions for stocking allow. Warmwater species include northern pike (*Esox lucius*), walleye (*Stizostedion vitreum vitreum*), yellow perch (*Perca flavescens*), goldeye (*Hiodon alisoides*), and burbot (*Lota lota*). Important forage species include white sucker (*Catostomus commersoni*) longnose sucker (*Catostomus catostomus*), lake chub (*Couesius plumbeus*), spottail shiner (*Notropis hudsonius*), flathead chub (*Platygobio gracilis*), longnose dace (*Rhinicthys cataractae*), pearl dace (*Semotilus margarita*), trout-perch (*Percopsis omiscomaycus*), brook stickleback (*Culaea inconstans*) and sculpin (*Cottus cognatus*).

Among coldwater species of fish, lake trout are considered to be the most environmentally sensitive and distributionally restricted. Their slow growth and late maturation qualities make them particularly susceptible to overharvesting by anglers. In addition, the demand for lake trout is high because of the pristine circumstances in which they are found, as well as their large size, and excellent flavour.

The demand for lake trout exceeds the productive capabilities of the 40 or so lakes (Alberta Energy and Natural Resources, 1984) that provide suitable lake trout habitat in Alberta. Some lakes, such as Namur are already feeling the pressure (Wallace and McCart 1984). All lakes capable of supporting viable populations of lake trout were therefore considered to be provincially significant.

The largest proportion of Alberta's commercial fishery is made up of Lake whitefish and cisco (i.e. tullibee). These two species account for 85-95% of the total provincial catch. Lake whitefish also comprise the largest portion of domestic fish captured and have recently become a target species for the recreational ice-fishing community. Apart from their direct economic contribution, lake whitefish and cisco are also the preferred food item of Alberta's most important game fish species including lake trout, walleye, and northern pike (Scott and Crossman, 1973).

Approximately 220 lakes (Alberta Energy and Natural Resources, 1984) are believed to support lake whitefish and cisco in Alberta. Many of these lakes occur in the northeastern part of the province. Spawning populations of as many as 500 000 lake whitefish are also known to utilize a portion of the Athabasca River above Fort McMurray (McCart et al. 1982). These river spawning whitefish are a major concern, particularly in light of potential environmental impacts related to industrial developments in the region. Because of the domestic, economic, ecological and recreational importance, all lakes utilized to a substantial degree by either lake whitefish or cisco were considered to be regionally significant. In cases where habitat containing lake whitefish or cisco contributed markedly to the provincial economy, a provincial level of significance was assigned.

Arctic grayling are one of the most sought after sportfish species inhabiting streams and rivers of the study area. They are also sensitive to changes in water quality, and overfishing. The latter impact frequently arises as a result of increased access into previously isolated regions. Wallace and McCart (1984) report significant reductions of Arctic grayling in the Horse River since roads were constructed into the area. Additional reductions are expected in conjunction with increased use of all-terrain vehicles and newly created access routes.

Spawning populations of Arctic grayling utilize a number of tributary systems feeding the Clearwater, Christina, Wabasca, and Athabasca Rivers (Wallace and McCart, 1984; Paetz, 1984). The mainstem and tributaries of the Ells and Firebag River are exceptionally important in this regard (Griffiths, 1973). The size, potential productivity, isolation and setting of the Ells and Firebag Rivers merits provincially significant status.

High Hill River is also an important spawning and rearing habitat for Arctic grayling. More importantly, it is considered to be the best small stream in the Fort McMurray region, and it contains a unique and naturally reproducing population of mountain whitefish (Griffiths, 1973). Mountain whitefish have been captured throughout the region; however, this is the first documented case of spawning, rearing and adult life history stages in a common drainage network northeast of Lesser Slave Lake.

Among warmwater sportfish, walleye is considered to be the most important species in Alberta (Alberta Fish and Wildlife Division, Fisheries Branch, 1985). Walleye are also fished for commercial and domestic purposes. Because of the high demand for walleye and because of their slow growth and late maturation qualities, numbers are declining. In some regions, the decline in numbers is leading to conflicts between sports and commercial fisheries.

Walleye occur in approximately 102 Alberta lakes, most of which are found within the Eastern Boreal Forest Region. Because of their declining numbers and restricted distribution, all lakes supporting substantial populations of walleye were considered to be regionally significant. Walleye populations worthy of provincial status are located in the Namur-Gardiner watershed, Lakeland Diversity Area, and in the Winefred Lake watershed (Alberta Fish and Wildlife files). Namur-Gardiner and Winefred Lake watersheds also support valuable fly-in sport fisheries and have in the past, been used as source areas for spawn collection. The spawn is utilized by the provincial walleye program for stocking lakes throughout Alberta.

Northern pike and yellow perch also represent important contributions to the recreational and commercial fisheries of the study area. Although they are not the target species of most sports fisheries, northern pike and yellow perch nevertheless make up the bulk of fish captures in Alberta. Both species exhibit widespread distribution and production levels appear to be meeting current angler demand (Alberta Fish and Wildlife Division, Fisheries Branch, 1985).

Northern pike and yellow perch are found in approximately 500 and 300 lakes throughout Alberta, respectively (Alberta Energy and Natural Resources, 1984). The presence of either species is insufficient to warrant a regional habitat status unless they occur together and in sufficient numbers to signify that a number of life history functions are being satisfied. Trophy fisheries of provincial significance exist for northern pike in Seibert and Gods Lakes.

Goldeye was once commercially fished in Alberta but demand for this species has declined since 1963 (Wallace and McCart, 1984). Their distribution is restricted to large turbid rivers, such as the Athabasca, and the turbid shallows of lakes (McPhail and Lindsey, 1970). They are a favourite food item of northern pike and walleye (Scott and Crossman, 1973) and are currently under-utilized as a sportfish.

Burbot are also considered as sportfish in Alberta. Restricted to large rivers and lakes, burbot are sometimes taken in commercial nets and are often utilized by the domestic fishery. Their predatory nature and preference for the hypolimnion of deep water habitats often leads to direct competition for food with lake whitefish and lake trout.

Fisheries for rainbow trout exist in a number of waterbodies that have been identified as being able to sustain a stocked population. Some examples include Horsehoe Lake, Chain Lakes, Unnamed (Twin) Lake, and Unnamed (Mile 18) Lake. These lakes are considered regionally significant because they offer a quality sportfishing alternative, thereby relieving the demands made upon surrounding natural populations.

7.4.2 Management Considerations

The most serious management concern related to fisheries in the Eastern Boreal Forest Region is the lack of inventory data on fish populations and habitat use. Only 3% of the waterbodies in the portion of the study area encompassed by the Fish and Wildlife Division's Northeast Region have been surveyed. Similar data gaps exist for the portion of the Peace River Region in the study area. The absence of detailed information on fish population movements and habitat use makes it difficult to develop effective management strategies and to provide adequate protection to important or sensitive habitats. Factors limiting fish production and habitat use need to identified and the conflict among different resource users needs to be resolved.

It is generally known that fish resources can be affected by a wide range of land use activities within a watershed. Surface disturbances associated with road construction, pipeline installation and construction of bridges, processing plants and other facilities can cause siltation of streams and loss of spawning habitat. Clearcut logging can result in the loss of protective bank cover and may alter the quantity and quality of surface runoff entering watercourses. Effluent from plants, feedlots, sewage and other pollution sources may be toxic to fish or affect the nutrient regime of the waterbody. Aquatic habitats are also vulnerable to changes in hydrologic regime from water control structures such as weirs, dams and diversion structures. Blockage of fish movements may result from improperly designed weirs or road crossings. Fish often migrate long distances to spawn in headwater streams.

Effects of these disturbances are most acute when they affect spawning habitats. Protection of these habitats requires site specific information on seasonal habitat use for each fish species. Maintenance of buffers to control siltation and prevent loss of streambank cover is an important consideration for all of these developments. Restrictions on the amount of vegetation clearing within sensitive watersheds is also required to prevent loss of habitat values resulting from increased runoff, channel erosion, siltation and increased temperatures.

Drainage of bogs or wetlands may also have a significant influence on fish habitat. In addition to serving as buffers for sediments or nutrients entering the waterbody, wetlands, fens, bogs and peatlands play a significant role in regulation of streamflow, by storing runoff and releasing it gradually into the streams.

A final concern relates to over-exploitation of fish populations as a result of increased access and fishing pressure in previously inaccessible or remote areas. Some species mature slowly and are more vulnerable to increases in fishing pressure. The Eastern Boreal Forest Region contains a number of trophy lakes which may not be able to withstand significant increases in recreational fishing.

7.5 Ecological Diversity

7.5.1 Background

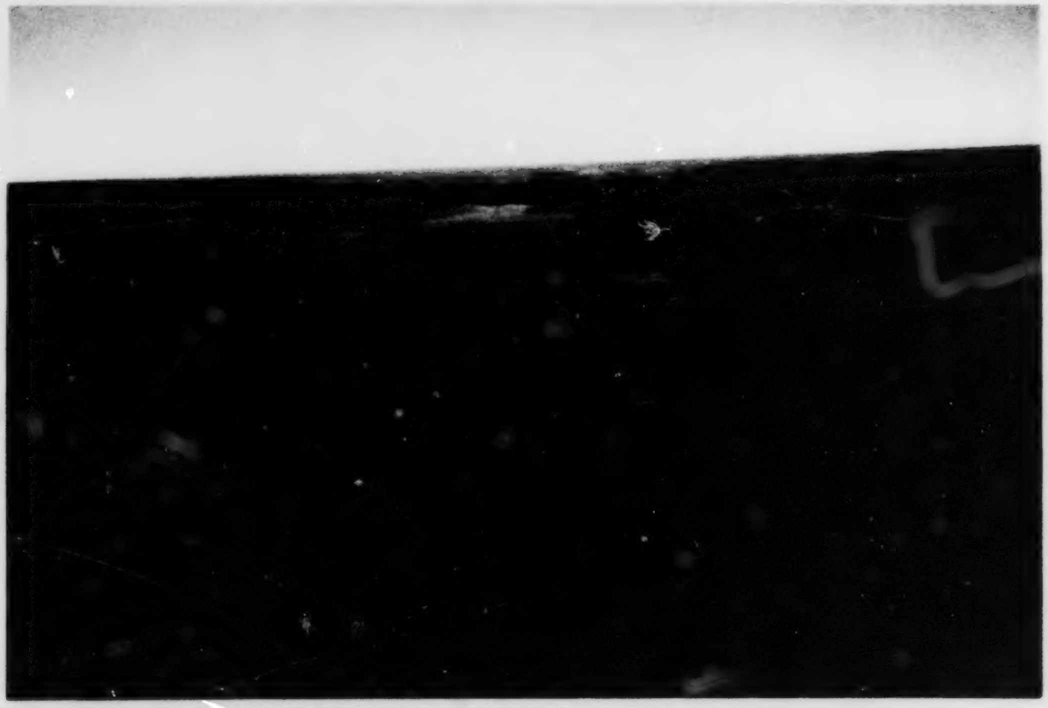
Ecologically, the Eastern Boreal Forest Region is extremely diverse. It lies predominantly within the Boreal Mixedwood Ecoregion, but contains outliers of the Boreal Northlands and Boreal Foothills Ecoregions (Strong and Leggat 1981). The terrain is mainly flat or undulating, although a series of elevated plateaus (Birch Mountains, Thickwood Hills, Stony Mountain, Pelican Mountain and Trout Mountain) and a number of deeply incised river valleys are also present. In terms of vegetation cover, the Boreal Mixedwood Ecoregion, which is transitional between the Aspen Parkland to the south and the predominantly coniferous Boreal Northlands and Boreal Foothills Ecoregions to the north and west, is characteristically diverse.

Despite the diversity that characterizes the study region as a whole, an effort was made during this study to identify areas of unusually high diversity (Table 10). This included areas that contained a high diversity of landforms, a high diversity of plant communities, or a high diversity of wildlife habitats (Photos 9 and 10). Because the distribution and type of plant communities and wildlife habitats is largely a function of topography and the types of landforms in the area, the diversity areas identified typically met all three of these criteria. Accordingly, these diversity areas comprised portions of the landscape that supported many community types and, in most cases, were characterized by a high degree of interspersion or spatial diversity.

Table 10. Significant diversity areas in the Eastern Boreal Forest Region of Alberta.

Diversity Area	Site #	Significance	Area (km^2)
Algar Lake Sandhills	21	Regional	100
Birch Mountains	500	Provincial	1000
Chipewyan	535	Regional	900
Clearwater Lake	556	Regional	170
Crow Lake	1	Provincial	110
Drowned Horse Creek	136	Regional	290
Fawcett	389	Regional	100
God's Lake	9	Regional	260
Gordon Lake	545	Regional	600
Horse River	538	Regional	170
Hospital Creek	540	Regional	250
Hunt Creek	543	Regional	190
Lakeland	12	Provincial	310
Landals River	518	Regional	70
Nipisi River	151	Regional	510
Owl River	11	Regional	170
Panny Tower	544	Regional	60
Peavine Prairie	30	Regional	140
Pelican River	127	Regional	480
Salteaux River	391	Regional	70
Shultz's Bog	8	Provincial	580
Surmont	604	Regional	330
Trout River Delta	371	Provincial	220
Watchusk Lake	547	Regional	270

Because these diversity areas are likely to support a large number of vegetation and wildlife species, they exhibit a high degree of biological diversity. Population theorists believe that the overall ecological stability of a region is a function of its biological diversity. In contemplating future potential development of a region such as northeastern Alberta, where most of the landscape retains its natural character, a legitimate question is "How important is it to purposely manage or set



Photos 9 and 10. The Trout River Delta Diversity Area (top) and the Algar Lake Sandhills (bottom) are examples of landscapes identified as significant natural areas because of their exceptional diversity.

aside areas of high biological diversity?" Samson and Knopf (1983) suggest that as competition for land continues to escalate through the remainder of this century, the most important conservation issue will be the preservation of a mosaic of habitats capable of sustaining a representative cross-section of native species. Preserving habitat so that floral and faunal diversity can be maintained is important not only for maintenance of genetic diversity and potential scientific-medical values, but for the long-term maintenance of consumptive, non-consumptive and cultural values associated with the different species of vegetation and wildlife.

In this study, rigid or well defined criteria were not used in selecting the areas of diversity. Landsat TM imagery proved to be the most helpful tool in identifying areas of diversity, although diversity areas were also identified during airphoto interpretation or during aerial reconnaissance surveys of the study region. No particular effort was made to ensure that the areas identified contained all of the landforms, vegetation types or wildlife habitat types that occurred in the region; however, together these diversity areas do represent the range of diversity that characterizes the study region as a whole.

7.5.2 Management Considerations

Although management of areas for diversity is not a new concept, resource managers have most often emphasized alpha, or within-habitat, diversity (Samson and Knopf 1983). Alpha diversity refers to species richness, the number of species in a community. The approach used in identifying diversity areas during the present study emphasizes beta, or between-habitat, diversity, and taken together these diversity areas provide a representation of gamma diversity, or the diversity that characterizes the entire region. Samson and Knopf (1983) argue that although some habitats along an ecocline might have low alpha diversity, in this case say sedge fens or black spruce forest, they may make a substantial contribution to beta or gamma diversity.

Although it is at least theoretically possible to manage a developed landscape in a way that maintains the diversity that existed in the area prior to development, the piecemeal nature that exemplifies most development of frontier areas makes it difficult to achieve any diversity objectives. One method of helping to ensure that the floral and faunal diversity of an area is not lost is to set aside or carefully manage representative landscape areas. Within these diversity areas many land uses would not be compatible. For example, land uses that involve the selective removal or alteration of even a single habitat type would affect the diversity of the area as a whole.

Development of a management framework for preserving the ecological diversity of the Eastern Boreal Forest Region requires a level of analysis that was not possible during the present study. The time available to conduct this study allowed only a preliminary identification of diversity areas. Identification and management of diversity areas should be carried out in accordance with clearly defined objectives as part of the resource management process for the region. These objectives might include consideration of both ecological and evolutionary processes. For example, both habitat size and habitat fragmentation are biogeographic concepts that have important implications for population viability of plant and animal species over large geographic areas. Population biologists now realize that population viability, or the likelihood that a population will continue to exist in an area (Shaffer 1981), is a direct function of the size of that population and the degree of isolation from other populations of the same species (Salwasser et al. 1984, Samson 1981, Soule 1981). A population that has high numbers and is widely distributed has a low probability of extinction, whereas populations that are fragmented with low genetic interchange may not be able to adapt to the range of intrinsic and environmental factors that can contribute to extinction of local populations (Shaffer 1981, Salwasser et al. 1984). The size of habitat areas required to sustain a population differ widely among species. The diversity areas identified during the present study are of themselves, insufficient to ensure the continued population viability of some of the wider ranging species, such as woodland caribou and moose.

8.0 SENSITIVITY OF SIGNIFICANT NATURAL FEATURES

Sensitivity ratings of significant natural features can provide an additional source of information for assessing potential effects of various types of development. In the present study, environmental sensitivity ratings were considered to be an evaluation of site or land performance in response to various types of disturbance. Changes resulting from development activities and surface disturbance can be measured in terms of soil, vegetation, wildlife habitat and hydrological parameters, as well as in terms of land use and social and economic values. Some disturbances involve minor, short-term changes that can be easily remedied with normal operating procedures while other lands may be more sensitive to disturbances because they contain one or more of the following characteristics:

- a very high susceptibility to erosion,
- severe limitations to revegetation, or
- distinctive, rare or unusual landforms and plant communities that are regionally, provincially, nationally, or internationally important.

Categories of significant natural features that were rated highly sensitive to a particular land use activity are expected to result in a total loss of environmental significance or value, or would at the very least, require major mitigation and very restrictive operating conditions to maintain their vital ecological functions. For example, landform/soil/vegetation units that are highly erodible, droughty, steep or unstable and have poor soil qualities would be considered highly sensitive to most land use activities. This may include eolian terrain (i.e. sand dune formations) which have low trafficability, are extremely vulnerable to wind and water erosion and require special revegetation practices because of the coarse texture soils and low levels of water and nutrient supplies for plants. Because of their high productivity and importance to fish and wildlife, wetlands and riparian zones are classified as highly sensitive to many types of land uses as well.

Moderate sensitivity ratings were assigned to those land use activities that may result in considerable changes to, or a considerable reduction in environmental significance of the site. Moderately sensitive significant natural features require restrictive operating guidelines for site or route selection and timing and consequently, require detailed mitigation plans if effective protection of the site is to be achieved. Significant natural features that are classified as generally not sensitive are expected to withstand most types of land use activity within normal operating conditions.

In the present study, steep slopes, rare species/plant communities, old-growth forests, caribou habitat and diversity areas were considered to be highly sensitive to most land use activities (Table 11). In terms of land uses, activities related to hunting, trapping, fishing and non-consumptive wilderness recreation were considered to have the least effect on significant natural features in the study area while surface mining and municipal/industrial related activities were rated as having the highest potential impact.

Table 11. Sensitivity of significant natural features to major types of land use activities.

● Highly Sensitive

◑ Moderately Sensitive

○ Generally Not Sensitive

Category of Significant Natural Features	Types of Land Use Activity								
	Hunting, Fishing and Trapping	Non-consumptive Wilderness Recreation	Facility-orientated Recreational Development	Roads and Highways	Utility Corridors	Oil and Gas Exploration and Development	Timber Harvesting	Surface Mining	Muncipal/Industrial
TERRAIN FEATURES:									
Glacial	○	○	◑	◑	◑	◑	○	●	●
Fluvial	○	○	●	●	◑	◑	◑	●	●
Eolian	○	○	●	●	●	●	●	●	●
Geologic	○	○	●	◑	◑	◑	○	●	●
Slopes	○	○	●	●	●	●	●	●	●
Peatlands	○	○	●	●	◑	◑	◑	●	●
HYDROLOGICAL FEATURES:									
Rivers and Creeks	○	○	◑	◑	◑	◑	◑	●	◑
Lakes	○	○	◑	◑	◑	◑	◑	◑	◑
Springs/Seeps	○	○	●	●	◑	◑	◑	●	●
VEGETATION FEATURES:									
Rare Species/Plant Communities	○	◑	●	●	●	●	●	●	●
Old-growth Forests	○	○	●	●	●	●	●	●	●
KEY WILDLIFE HABITATS:									
Caribou	◑	◑	●	●	◑	●	●	●	●
Moose	◑	○	◑	●	◑	◑	◑	◑	◑
Furbearers	◑	○	◑	◑	◑	◑	◑	◑	◑
Colonial Nesting Birds	◑	◑	●	◑	◑	●	◑	◑	●
Waterfowl	◑	○	◑	◑	○	◑	◑	◑	●
FISH	◑	○	◑	●	◑	◑	◑	◑	◑
DIVERSITY AREAS	○	○	◑	●	●	●	●	●	●

9.0 CONCLUSIONS

The present study represents an initial attempt to identify significant environmental features and landscapes in the boreal mixedwood region of northeastern Alberta. As we have stressed throughout this report, inventories have not been conducted for most of this region, and it would be erroneous to consider the list of significant natural features presented as a full and complete inventory of sites worthy of conservation. Some of the sites identified have already been seriously degraded by various forms of disturbance and there is a real need to conduct systematic inventories of the important natural resources of the region prior to widespread development. Most companies involved in resource development now accept a responsibility for protection of significant natural features, however, the absence of baseline inventory data makes it difficult to make environmentally sound planning decisions.

In the preceding sections we have attempted to identify some of the major management issues facing each of the principal types of significant natural features. However, there is a need to develop an overall environmental management strategy for ensuring long-term protection of the area's significant features. All of the sites identified require some level of protection. The type and level of protection required may vary all the way from strict legal preservation to simply applying operating restrictions. Some of the sites identified can, with proper environmental protection, accommodate a range of other land uses, whereas other sites should be formally protected and set aside.

Alberta has an existing legislative framework for protecting natural ecosystems, that includes designation as provincial parks, wilderness parks, wilderness areas, natural areas or ecological reserves. Some of these might provide suitable mechanisms for protecting certain significant natural features. For example, a number of the significant natural features identified serve as good representatives of significant boreal ecosystems and therefore are considered appropriate for consideration as natural areas or ecological reserves. The Birch Mountains, because of their diversity, uniqueness, importance for certain species of plants and animals, and relatively pristine condition, merit consideration as a wilderness area or wilderness park. Several of the rivers in the area, including the rapids reach of the Athabasca River, the upper Clearwater River, the lower Christina River, the canyon section of the Wabasca River and the Ells River all warrant protection as some form of wilderness river. Some of the significant natural features identified do not warrant legislative protection but do require protection in the form of zoning or development restrictions to maintain their inherent environmental values. This would include many of the sites identified as significant on the basis of their value as fish or wildlife habitats.

A number of approaches can be used to manage site containing significant natural features. One approach would be to deal with development applications on a case-by-case basis, conducting impact assessments where necessary, or applying development restrictions or environmental protection requirements through the normal government referral process. A better approach might be to adopt a more proactive stance by developing an overall conservation strategy and preparing site-specific management plans for sites containing significant natural features in advance. A policy for management of significant natural sites could be developed under or in conjunction with the forthcoming Alberta Conservation Strategy. The report of the Expert Review Panel on Forest Management (1990) also called for development of a forest management strategy for Alberta. In developing an overall conservation or forest management strategy, there is a need to include goals and priorities for conservation and management of significant natural sites in northern regions.

The management strategy for significant natural features should consider some of the guiding principles suggested by Eagles (1984). In particular:

- Long-term resource protection and management should take precedence over short-term economic gains which result in the loss of future options.
- Management of significant natural features should be integrated with other resource management efforts including forestry, recreation and agriculture.

- Proposed developments with potential to significantly affect significant natural features should be subject to environmental impact analysis to identify levels of impact and appropriate mitigative measures.
- Maintaining an environmental data base and information dissemination are important aspects of significant natural features management. Maps and supporting documentation should be widely available so that they can be used for planning purposes or for increasing public awareness.

The strategy should also consider the serious problems of habitat fragmentation and cumulative effects. Habitat fragmentation and alienation are major public issues in developed areas of Canada. As the extent of development increases in northern Alberta, so will the concern that habitat fragmentation will affect the viability of some of our important wildlife species. This will be a particular concern for species such as moose and woodland caribou that occupy large home ranges and may undertake extensive movements between seasonally important ranges.

We now know that individually insignificant impacts have the potential to accumulate in time and space to cause significant environmental change. This piecemeal loss or degradation of habitat is sometimes referred to as 'nibbling'. Eventually a point may be reached where even a comparatively minor incremental impact could affect a population's viability. In some cases cumulative effects can occur in a synergistic manner. For example, a road constructed across the Athabasca River by the provincial government in the 1970s, in support of planned oilsands development, opened the area on the east side of the river to timber harvesting and increased hunting pressure. A management strategy for significant natural features should consider the potential for cumulative effects resulting from existing, proposed, and possible future development on the sites values and functions.

In addition to developing an overall strategy for managing significant natural features, there is a need to develop site-specific conservation plans for these sites, particularly in areas where development is imminent. Some of the requirements to be considered in developing these site plans include:

- the need for an inventory. A detailed biophysical inventory is required to provide information necessary for developing management guidelines, delineating or refining boundaries of significant natural sites, and establishing an environmental benchmark;

- the need to identify incompatible land uses;
- the need to determine buffer requirements;
- the need to identify specific management requirements for maintaining viable populations of species identified as rare, threatened or endangered;
- the need to consider all stakeholders. Significant natural features planning should be viewed as an integrated planning process that derives input from government, private organizations, native groups and conservation organizations.

There is also a need to develop some new and innovative strategies for protecting certain types of significant natural features. Key moose or caribou areas, scenic rivers, and sensitive watersheds are examples of features that are vulnerable to significant impact under present management and operating procedures. These strategies might include management agreements with operators of Forest Management Areas, oil companies, and native groups. The problem of over-exploitation of fish and wildlife populations as a result of increased access into remote areas is a serious management issue that is not being adequately dealt with at the present time. Legislative solutions appear difficult to enact and enforce; consequently, cooperative agreements with all of the parties that are directly or indirectly contributing to the problem may be more helpful. The Alberta Fish and Wildlife Division, as the agency that is directly responsible for managing these resources, should assume a lead role in bringing about these types of agreements.

It should also be emphasized that identification and management of significant natural features is part of, but not a substitute for, proper management of the area's resources. For example, extensive areas of productive habitat exist throughout the Eastern Boreal Forest Region that, although they were not identified as significant natural sites, require careful management to maintain the region's important fisheries and wildlife resources.

A final point concerns the need for immediate action. The pace of resource development in the Eastern Boreal Forest Region is escalating rapidly. Extensive oil and gas, and pipeline development is now occurring in the Winefred Lake area, the Liege River area, and a number of other parts of the region that are generally thought to be remote and undisturbed. Significant stands of old-growth forest have been lost to timber harvesting and other types of development over the last ten years. The need for conducting inventories and developing an overall conservation strategy for the region is immediate and imperative. Resource information needs in the region have long been ignored and the provincial government now has a responsibility to fund the necessary programs and provide direction before the significant environmental features of the region are irreparably altered. Industry shares this responsibility and must begin to place wise stewardship of the areas resources ahead of short-term economic gains.

10.0 INFORMATION GAPS

Throughout this report, reference has been made to the general lack of information on most of the area's natural resources. Apart from the research conducted under the AOSERP program during the 1970s and inventories conducted by a number of oilsands companies during the same period, scientific studies in the region have been minimal. Fish and wildlife population surveys conducted by the Alberta Fish and Wildlife Division cover less than 15% of the study area and much of this information may no longer be current. Extensive portions of the area have never been surveyed. Data gaps are particularly conspicuous with respect to the distribution of rare plant and animal species. Efforts to identify locations of rare plant species or communities have been so minimal that the list of known sites may well represent less than 1% of the sites that actually occur in the area.

Because of these information deficiencies, the present study can only be considered a reconnaissance-level inventory of significant natural features. There is a pressing need for detailed inventories of these resources prior to widespread development. Many more sites may exist that should be protected, and field investigations are required to verify the value of significant natural features that have been identified and to determine their sensitivity to various forms of development. Data gaps with a high priority for further study include:

- distribution of rare plant species and communities. The most significant concentrations of rare plants should be identified and included within significant natural sites.
- present status and locations of nesting areas and other important habitats for rare or sensitive wildlife species such as the white pelican, double-crested cormorant, osprey and bald eagle
- locations of important fish habitats
- locations of significant old-growth forest stands, particularly stands of deciduous species and balsam fir, which cannot be identified through the Phase 3 forest inventory.
- locations of seasonally important habitats (including calving areas, wintering areas and migration routes) for moose and woodland caribou. Our present knowledge of the abundance, distribution and life history of woodland caribou in the study region is completely inadequate for developing detailed conservation and management programs.

- information on the importance of large peatlands for stabilizing stream flow in creeks and rivers. Some of the large peatlands in the study area serve as recharge areas while others are discharge areas. The location and importance of local aquifers are unknown.

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APPENDICES

APPENDIX I: Old-growth forest stands and areas needing further evaluation

Analysis of the Phase III forest inventory data for coniferous-dominated stands showed several classes of stands (unusual canopy types, concentrations of old-growth, etc.) that should be evaluated further as to their value in old-growth conservation.

1. Area (ha) occupied by various age classes in the study area.

Age (yrs)	Athabasca Forest	LaBiche Forest	Slave Lake Forest	TOTAL
105	1397	10394	2657	14448
115	5902	4988	1397	12287
125	23945	82572	30671	137188
135	50195	10932	24497	85624
145	4865	7790	19281	31396
155	13058	1157	9536	23751
165	2522	1557	3353	7432
175	1889	84	845	2818
185	34	165	42	241
195	155	-	42	197
205	7	-	276	283
215	26	-	-	26
225	-	-	-	-
235	9	-	-	9

2. Coniferous-dominated stands 190 years and older.

Age	FMU	Twp	Rg	M	St No	Canopy
190	A05	091	14	4	0047	Sw
190	A07	098	10	4	0212	SwA
190	A07	100	09	4	0208	Sw
190	A07	100	09	4	0220	Sw
190	A07	100	09	4	0314	SwSb
195	A01	081	09	4	0099	PSb
195	S13	091	20	4	0228	Sb
195	S13	091	21	4	0220	Sb
195	S13	091	21	4	0227	Sb
195	S13	091	21	4	0236	Sb
195	S13	091	21	4	0307	Sb
195	S13	091	21	4	0312	Sb
205	A08	097	17	4	0006	Sw
205	S04	077	22	4	0055	SbSw

Age	FMU	Twp	Rg	M	St No	Canopy
205	S04	077	22	4	0082	SbSw
205	S04	077	22	4	0084	SbFbP
205	S04	077	22	4	0197	SbSw
205	S04	077	22	4	0200	Sb
205	S04	077	23	4	0202	Sb
205	S04	077	23	4	0205	Sb
205	S04	077	23	4	0214	Sb
205	S04	077	23	4	0215	SbP
205	S04	077	23	4	0218	Sb
205	S04	079	23	4	0082	SbSwA
205	S14	091	03	5	0200	Sb
205	S14	091	03	5	0210	Sb
205	S14	091	03	5	0214	Sb
205	S14	091	03	5	0216	Sb
215	A02	089	03	4	0203	SwA
215	A02	089	03	4	0204	SwA
215	A02	089	03	4	0206	SwA
215	A02	089	03	4	0219	SwA
235	A02	088	06	4	0517	Sw

3. Townships with concentrations of old-growth forest.

1	72-19-W4	3	79-4&5-W5
	73-18&19-W4		80-3 to 7-W5
	74-18-W4		
	75-14,15,18-W4	4	95-8-W4
	76-14 to 18-W4		96-9-W4
	77-13 to 18-W4		97-9,11,12-W4
	78-15,17-W4		98-9,10,12-W4
	79-14,15-W4		99-10,11-W4
	80-15-W4		100-9,11-W4
2	76-22&23-W4		
	77-21 to 24-W4		
	78-22&23-W4		

4. Coniferous-dominated old-growth stands >400 ha in area.

Area	FMU	Twp Rg M	StNo	Canopy
1510	A07	098 09 4	0055	P
1099	A07	097 12 4	0131	SwA
654	A05	092 11 4	0077	SwA
592	L03	077 18 4	0168	SwA
534	L03	077 17 4	0192	SwA
502	A07	100 11 4	0340	SwA
449	S14	093 06 5	0134	SwA
440	L03	077 17 4	0214	SwA
439	A05	090 11 4	0209	SwA
408	S08	080 06 5	0289	SwA

5. Some canopy types containing tamarack (Lt - *Larix larcina*) are among the rarer old-growth canopy types in the study area. The following Forest Management Units contain these canopy types.

Type	Forest Management Unit	Area (ha)
PLt	A04	9.0
PLt	L01	8.2
SwLt	S04	46.9
Lt	L01	15.1
Lt	L02	22.4
Lt	S07	35.6

6. Although the amount of paper birch in the study area is underestimated in the Phase III data since it has seldom been separated from other deciduous species, a concentration of mixed paper birch and tamarack old-growth forest has been identified in 82-20-W4 and 82-21-W4 and comprises the following stands:

Twp Rg M	FMU	Stand	Age
082 20 4	S04	101	125
082 20 4	S04	186	155
082 20 4	S04	199	155
082 20 4	S04	212	155
082 20 4	S04	234	155
082 21 4	S04	098	125
082 21 4	S04	228	155
082 21 4	S04	240	155
082 21 4	S04	250	155
083 20 4	S12	002	155
083 20 4	S12	003	155
083 20 4	S12	030	155
083 20 4	S12	043	155
083 20 4	S12	053	155
083 20 4	S12	072	155

SIGNIFICANT NATURAL FEATURES OF THE EASTERN BOREAL FOREST REGION OF ALBERTA

Alberta Forestry, Lands and Wildlife

Database

D.A. Westworth & Associates Ltd.
Edmonton, Alberta

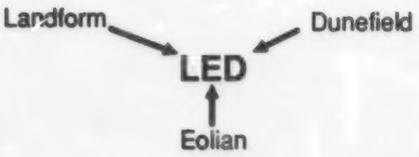
December, 1990

CODE LIST

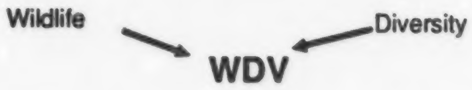
The following section of the report provides a listing of the database file developed during the course of the study. It includes a code list that was used to denote key and associated environmental features of each significant natural site, a complete hardcopy listing of the database file and a 31/2" 720K diskette that contains the digital version of the file. The database file, which was created using dBase III+, contains the following information:

Code	Description	Code	Description
NBR	Site Number	COMM	Additional Comments
NAME	Site Name	KFC	Key Feature Code
TWP	Township	SIG	Significance Level
R	Range	VEG	Associated Vegetation Features
M	Meridian	WLD	Associated Wildlife Features
NTS	Topographic Mapsheet (1:50,000)	LDF	Associated Landform Features
FLTLIN	Flight Line	FSH	Associated Fish Features
PHOTNUM	Aerial Photograph Number		

Use of the hardcopy database listing to obtain more specific information about any of the significant natural sites can be achieved by referring to the series of maps appended to the end of the report and noting the site number. The listing is numerically ordered and once the site has been located, information about the specific features of the site may be obtained. The following code list is based on a unique combination of three letters that represent the list of significant natural features considered during the study. The first letter denotes the major biophysical component that the significant natural feature represents. In most cases, the second letter represents a sub-division of the biophysical component and the third letter indicates the specific feature of the site. For example:



However, in some instances, two letter combinations are used to define the feature. In these cases, the first letter denotes the biophysical component while the last two letters refer to the specific feature. For example:



Code List - dBase III+

Feature	Code
LANDFORMS:	L
Glacial	*G*
Moraine	M
Esker	E
Kame	K
Hummocky	H
Flutings	F
Crevasse Fillings	C
Doughnuts	D
Outwash Channel	U
Fluvial	*F*
Meander Scars	S
Oxbows	O
Rapids	R
Terrace	T
Flood Plain	P
Falls	F
Meander Reach	M
Under Fit Stream	U
Beach Ridge	B
Delta	D
Point Bars	Q
Fan	A
Eolian	*E*
Dune Field	D
Eroded Dunes	E
Dune/Wetland Complex	X
Geologic	*R*
Bedrock Outcrops	L
Bitumen Outcrops	B
Karst/Sinkhole	K
Slopes	*S*
Escarpment	E
Slumps	S
Steep	T
Diversity	DV
PEATLANDS:	P
Bog	*B*
Palsa/Raised	P
String	S
Bowl	W
Channel	C
Blanket	L
Patterned/Plateau	T
Fen	*F*
String	S
Channel	C
Discharge	D
Saline	N
Patterned	P
Permafrost	P
Thermokarst	T
Patterned Ground	G

Feature	Code
HYDROLOGICAL:	R
River	*R*
Lake	*L*
Creek	*C*
Springs	*SP*
Soaphole	*SH*
Seeps	*SE*
VEGETATION:	V
Community Diversity	*DV*
Significant Plant Community	*PC*
Rare Plant Species	*RS*
Significant Plant Species	*SP*
Old-growth Stand	*OG*
WILDLIFE:	W
Ungulates	*U*
Moose	*M*
Caribou	*C*
Furbearers	*F*
Otter	*O*
Marten	*A*
Lynx	*L*
Colonial Nesting Birds	*X*
White Pelicans	*P*
Double-crested Cormorants	*D*
Great Blue Herons	*H*
Terns/Grebes/Gulls	*T*
Raptors	*R*
Bald Eagle	*B*
Osprey	*Q*
Waterfowl	*W*
Habitat Functions:	
Habitat Diversity	DV
Key Habitat	H
Overwintering	O
Nesting	N
Staging	S
Feeding	F
All (nesting, staging, feeding)	A
Mineral Lick	ML
Movement Corridor	MC
FISH:	F
Sportfish	*S*
Migration Route	M
Spawning	S
Overwiwntering	O
Feeding	F
Rearing	R
All (all of above)	A
Commercial/Domestic Fishery	*CF*
Trophy Lake	*TL*
Unknown	*U*

NBR	NAME	TWP	RG	M	NTS	KFC	KFC	KFC	S	FLTLIN	PHOTNUM	VEG	VEG	VEG	WLD	WLD	WLD	LDF	LDF	LDF	FSH	FSH	FSH
001	Crow Lake Diversity Area	078	14	4	83P	VRS	VDV	LDV	P	AS2791	290				WDV	WBN		RL	LGH	PBT	FS		
002	Eymundson Sinkholes	098	10	4	74E	LRK			P	AS3051	132							RL					
003	McClelland Lake Fen	097	09	4	74E	PFP	VRS	VSP	P	AS3051	109				WWN								
004	La Saline Springs Natural Area	093	10	4	74E	RSP	VRS	WWA	P	AS3051	7				WDV	WML		RL			FS		
005	Clearwater Springs	088	05	4	74D	VRS	RSP		P	AS3059	244-245				WML								
006	Whitemud Falls Ecol. Reserve	089	01	4	74D	LFF	VSP	RR	R	AS3060	124-126												
007	Namur Lake	097	17	4	84H	FSA	FTL	WPN	P	AS3147	182-184				WDN	WBN	WWS	RL			FCF		
008	Schultz's Bog Diversity Area	089	18	4	84A	WCH	PBP	LDV	P	AS3059	215-218	VDV	VPC		WFH			LEX	LGC	PFP			
009	Gods Lake Diversity Area	090	01	5	84B	VDV	LDV	WDV	R	AS3060	205				WWA			RL			FSA		
010	Burnt Lakes	095	25	4	84H	VDV	VPC	FSA	R	AS3146	263				WDV	WMF		RL			FCF		
011	Owl River Diversity Area	069	13	4	73L	VDV	LDV	WMH	R	AS2525	45-46				WDV			RR	LGH	PBT	FSA		
012	Lakeland Diversity Area	067	10	4	73L	RL	FSA	LDV	P			VDV	VSP		WMH						FCF	FTL	
013	Firebag River Delta	100	09	4	74E	LFO	LFS	VDV	R	AS3051	187	VOG			WDV	WWN		LFQ			FSA	FM	
015	Sand Lake	100	15	4	84H	WWS	FSA	RL	R	AS3148	199				WBN	WQN							
016	Water Lily Lake Slumps	100	16	4	84H	LSS	LDV	VDV	R	AS3148	196	VDV											
017	Gardiner Lakes	098	16	4	84H	FSA	FTL	WWS	R	AS3147	283				WPF	WBN	WBN	RL					
018	Ells River	094	15	4	84H	FSA	LFO	VDV	P						WMC			RR	LRL				
019	Horseshoe Lake	093	10	4	74E	WWA	VSP	RL	R	AS3051	6							LFT					
020	Liege River	094	25	4	84H	VDV	LDV	RR	R														
021	Algar Lake Sandhills	086	17	4	84A	LEX	VDV	WDV	R	AS3058	220				WFH	WCH		LDV	PFS	RL			
022	Boivin Creek Peatland	081	17	4	84A	PFD	WCH	VDV	P	AS3056	228							RC					
023	Long Lake	089	04	5	84B	FSA	FCF	WWN	R	AS3060	67							RL					
024	High Hill River Springs	089	03	4	74D	RSP	VSP	WML	R	AS3060	121												
026	Gordon Lake	086	03	4	74D	WWA	RL		P	AS3058	245							PBT			FSA		
028	Christina River Peatlands	083	08	4	74D	PBT	PFP	LDV	R	AS3057	245	VDV			WCH			PBT					
029	Newby River	082	03	4	74D	WMC	LFM	RR	R	AS3056	261	VDV			WFH						FSS		
030	Peavine Prairie Diversity Area	071	12	4	73M	LDV	WMH	VDV	R	AS2790	51-52				WDV			LEX	RL	PFP			
031	Firebag River	100	08	4	74E	FSA	WMO	LDV	P			VDV	VOG		WAH	WMC		RR	LFM	LRL			
032	Marguerite River	100	07	4	74E	FSA	LDV	WMH	R			VDV						RR					
033	Christina Crossing	084	03	4	74D	VOG			R	AS3057	253-254												
034	Muskeg River (North)	095	09	4	74E	FSA			R	AS3051	568-385				WMH	WOH		RR					
035	Egg L.-Algar L. Caribou Area	082	12	4	74D	WCH	PFP	VDV	P									LDV					
036	Kearl Lake	096	08	4	74E	WWS	VRS	RL	R	AS3051	59												
037	Hartley Creek	094	09	4	74E	WOH	FSA	RC	R	AS3051	32-56												
038	Pierre River	098	11	4	74E	WMC	FSS	WFH	R	AS3051	28-31							RR			FSR	FSF	
039	Kearl Lake Moose Area	096	08	4	74E	WMH	WMC	RC	R	AS3051	85-87												
040	Steepbank River	091	08	4	74D	FSA	WMC	RR	R	AS3098	110-238												
042	Christina River OGF	087	06	4	74D	VOG			R	AS3059	120							RR					
043	Clarke Creek	090	08	4	74D	FSS	FSR	RC	R	AS3060	239-241												
045	Clearwater River	089	03	4	74D	FSA	WMO	LDV	P			VDV			WMC	WML		RR	LFM	LFF			
046	Edwin Creek OGF	089	03	4	74D	VOG			R	AS3060	122												
049	High Hill River	091	03	4	74D	FSA	WMC	RR	P			VDV						LSS	LRL				
052	Gordon River	086	04	4	74D	WMC	RR		R	AS3058	118-244												
053	Mink-Grew Lakes OGF	091	21	4	84A	VOG			R	AS3098	85-86												
057	Gipsy Lake	086	02	4	74D	FSA	FCF	WBS	R	AS3058	247-248							RL					
060	Birch Lake	085	03	4	74D	WPN	RL	WDN	P	AS3058	119-120							RSE			FSA	FCF	
062	Saprae Creek	088	07	4	74D	FSS	FSR	RC	R	AS3059	239										FSF		
063	Saline Creek	088	08	4	74D	FSS	FSR	RC	R	AS3059	237												
064	Gregoire River	086	08	4	74D	FSA	WMC	RR	R														

NBR	NAME	TWP	RG	M	NTS	KFC	KFC	KFC	S	FLTLIN	PHOTNUM	VEG	VEG	VEG	WLD	WLD	WLD	LDF	LDF	LDF	FSH	FSH	FSH
065	Gregoire Lake	086	08	4	74D	FSA	FCF	WWS	R	AS3058	237				WBN			RL					
067	Georges Lake	084	05	4	74D	FSA	FCF	RL	R	AS3057	249												
069	May River	076	10	4	73M	FSA	WMC	RR	R	AS2791	142							LFM	LGU				
071	Kettle River	080	05	4	73M	WMC	FSA		R	AS2770	225				WMH			RR					
077	Kirby Lake	075	05	4	73M	FSA	FCF	RL	R														
078	Christina Lake/Jackfish River	076	06	4	73M	FSA	FCF	WWN	R	AS2791	146-150	VDV						LDV	RL	RR			
079	Wappau Lake	075	11	4	73M	WWN	WBA		R	AS2791	65	VDV						LGU	RL		FSA	FCF	
080	Base Lake and Creek	077	12	4	73M	FSA	LGU		R	AS2791	212-217	VGV			WMH			RL	LDV	RC	FCF		
081	Surmont Creek	085	08	4	74D	FSS	FSR	RC	R	AS3058	111										FSF		
082	Winefred River	081	04	4	74D	FSA	WOH	VDV	R	AS3056	119-120							RR	LDV				
083	Watchusk Lake	083	02	4	74D	FSA	WFH		R	AS3057	125	VDV						RL	PBT				
084	Banana Lake	067	26	4	83I	VOG	WQN		R	AS2776	61-62							RL			FSA	FCF	
088	Cowper Lake	080	03	4	73M	WWN	FSA	RL	R	AS2770	230										FCF		
089	Bohn Lake	080	05	4	73M	WWN	FS	RL	R	AS2770	226												
090	Winefred Lake	075	04	4	73M	FSA	FTL	WBN	P	AS2792	76-77				WRA	WWA	WDN	RL			FCF		
091	Grist Lake	074	04	4	73M	FSA	RL		P	AS2790	295												
093	House River Meltwater Channel	077	14	4	83P	FSA	LGU	WMH	R			VDV			WMC			RR	LDV	LFU			
096	Hangingstone River	085	09	4	74D	FSA	WMC	RR	R			VDV						LFM	LFU	LRL			
098	Horse River	089	09	4	74D	FSA	WMO	LFM	R			VDV			WMC			RR	LFU	LRL			
101	Algar Lake	084	15	4	84A	WWA			R	AS3057	229							RL					
104	Buffalo Creek Lake	087	20	4	84A	WPS	VDV	WFH	R	AS3059	90	VDV						RL	LFD				
113	MacKay River	094	11	4	74E	FSA	WMO	LFM	R			VDV			WFH	WMC		RR	LRL				
115	Dunkirk River	093	20	4	84H	FS	RR	WMC	R			VDV						LFM					
118	Dover River	094	12	4	74E	FSA	VDV	RR	R						WMC	WFH		LFM	LRL	LFU			
120	Namur River	098	16	4	84H	FSA	RR		R	AS3147	282												
124	Pelican OGF	077	22	4	83P	VOG			R	AS2791	193												
125	Pelican Mountains	076	23	4	83P	VPC	VSP	WDV	R	AS2791	113-114	VDV	VOG	VRS	WMH	WFH		LDV	LSE	LGM			
127	Pelican River Diversity Area	079	19	4	83P	LDV	VDV	WDV	R	AS2791	281-283	VPC			WMH	WFH		LFM	LGC	RL			
128	Pelican Lake	078	21	4	83P	WPN	WWA	RL	P	AS2791	278				WDN	WBN							
129	Wabasca River (Upper)	085	24	4	84A	FSA	WMH	RR	P			VDV			LFM								
132	North Wabasca Lake	081	26	4	84A	FSA	FCF		P	AS3056	77				WFH			RL					
133	South Wabasca Lake	080	25	4	83P	FSA	FCF	WWA	P	AS2770	184				WFH			RL					
135	Sandy Lake	079	22	4	83P	FSA	FCF	WWA	R	AS2770	113							RL					
136	Drowned Horse Creek Diversity	078	24	4	83P	LDV	VDV		R	AS2770	112	VSP			WMH	WFH		RL			FSS		
137	Godin Lake	082	01	5	84B	RL			R	AS3056	209												
138	Weaver Lake	080	01	5	83O	WWN	FS	RL	R	AS2770	179												
139	McLeod Lake	080	01	5	83O	WWN	FSA	RL	R	AS2770	178										FCF		
140	Sandez Lake	080	02	5	83O	FSA	FCF	RL	R	AS2770	178												
141	Pastecho River	082	02	5	84B	RR	RL	LDV	R	AS3056	72	VDV											
144	McMillan Lake (West)	078	04	5	83O	FSA	FCF	RL	R	AS2791	263												
145	Unnamed Lake	086	04	5	84B	RL	WHN	WDN	R	AS3058	194-196												
146	Muskwa Lake	082	05	5	84B	FSA	FCF	RL	R	AS3056	200				WWA								
147	Muskwa River	082	03	5	84B	RR	LDV	WMO	R	AS3056	200-208	VDV			WMC			LGC	LGS		FS		
148	Calling River	073	23	4	83P	FSA	LDV	VDV	R	AS2790	186				WMH	WMC		RR	LFM				
149	Calling Lake	072	22	4	83P	FSA	FCF	WWS	P	AS2790	109				WBN			RL	LFB				
150	Rock Island Lake	075	22	4	83P	FSA	FCF	WWA	R	AS2791	44				WBN			RL					
151	Nipisi River Diversity Area	080	06	5	83O	WDV	VDV	LDV	R	AS2770	96							RL	RC	RR			
152	Nipisi Lake	078	07	5	83O	FSA	FCF	RL	R	AS2791	251				WWA								
157	Legend Lake	097	19	4	84H	FSA	RL		R	AS3147	180												

NBR	NAME	TWP	RG	M	NTS	KFC	KFC	KFC	S	FLTLIN	PHOTNUM	VEG	VEG	VEG	WLD	WLD	WLD	LDF	LDF	LDF	FSH	FSH	FSH
158	Christina River (Lower)	087	05	4	74D	FSA	WMO	WRN	P	AS3059	120	VDV			WMC	WFH		RR	LDV				
159	House Creek	091	25	4	84A	WMC	RC	FSA	R	AS3098	78-79												
162	Mink Lake	091	21	4	84A	RL	WPS	WPF	R	AS3098	86												
163	Grew Lake	091	20	4	84A	WPS	WPF	RL	R	AS3098	87												
165	Chipewyan Lake	092	22	4	84A	FSA	FCF	RL	R	AS3098	209												
169	Wood Buffalo River	086	23	4	84A	RR	RL	LFM	R	AS3058	87												
175	Ells Tower OGF	094	15	4	84H	VOG			R	AS3146	183												
176	Utikuma River	083	05	5	84B	WMC	RR		R	AS3057	68	VDV									FSA		
178	Bat Lake	084	06	5	84B	RL			R	AS3057	191-192												
180	Trout River Channel	084	03	5	84B	LGU	LFM	WFH	R			VDV			WMH	WWN		RR			FSA		
182	Maria Lake	086	04	5	84B	WWN	RL		R	AS3058	194-198												
183	Graham Lake	087	04	5	84B	FSA	FCF	WDN	R	AS3059	69				WWA			RL					
184	Peerless Lake	088	05	5	84B	FSA	FCF	RL	P	AS3059	200-201				WWA								
185	Vandersteene Lake	088	03	5	84B	FSA	FCF	RL	R	AS3059	202				WWA								
186	Firebag River OGF	100	09	4	74E	VOG	LFM		P	AS3051	186-188												
187	Goodfish Lake	089	05	5	84B	FSA	FCF	RL	R	AS3060	65				WWN								
191	Woodenhouse River	087	24	4	84A	RR	LFM	WMC	R	AS3059	207												
195	Panny River	095	05	5	84G	RR	RL	LDV	R			VDV			WMC						FS		
197	Hunt Creek OGF	093	06	5	84G	VOG			R	AS3146	62-64												
198	Wandering River	073	17	4	83P	FSA	WMC	LFM	R	AS2790	196							RR					
201	Owl River	071	11	4	73M	FSA	RR	LFM	R	AS2790	52				WMC			LDV					
202	Logan River	073	12	4	73M	FSA	LGU		R	AS2790	204	VDV			WMH			RR	LFA	LFU			
203	Goodwin Lake	074	11	4	73M	WHN	LGU	FS	R	AS2790	281	VDV			WRN			RL			FCF		
204	Clyde River	071	12	4	73M	WMC	FS	RR	R	AS2790	51				WCH								
205	Clyde Lake	073	10	4	73M	WWN	FSA	RL	R	AS2790	208				WBN						FCF		
207	Wiau Lake	074	09	4	73M	WWN	WQN	RL	R	AS2790	285				WCH								
208	Behan Lake	073	11	4	73M	RL	FSA	FCF	R	AS2790	207				WCH			RL					
210	Logan Lake	070	09	4	73M	FSA	FCF	WWN	R	AS2776	223-224				WBN			RL					
211	Heart Lake	070	10	4	73M	FSA	FCF	RL	P	AS2776	222				WHN	WBN							
212	Francis Lake	069	11	4	73L	FSA	FCF	RL	R	AS2525	102				WBN								
213	Piche Lake	070	11	4	73M	FSA	FCF	RL	R	AS2776	221												
214	Dillon River	075	02	4	73M	RR	WMC	WDV	R	AS2791	156												
216	Christina Uplands Moose Area	078	08	4	73M	WMH	LDV	VDV	R	AS2791	295-304												
217	Christina River (Middle)	079	06	4	73M	FSA	LFM	WMC	R	AS2770	143	VDV			WFH	WMH		RR					
218	Christina River (Upper)	079	10	4	73M	FSA	LFM	VPC	R	AS2770	135	VDV						RR	LDV				
219	Rourke Creek	069	26	4	83I	FSS	FSR	LDV	R	AS2776	115	VDV						RL	RC		FSF		
220	Lawrence Lake	069	25	4	83I	WWN	FSA	FCF	R	AS2776	142							RL					
221	Spotted Horse Lake	068	26	4	83I	WWN	FS	RL	R	AS2776	115												
224	Blefgen Lake	067	26	4	83I	WRH	FS	RL	R	AS2776	87-88												
225	Brereton Lake	067	26	4	83I	WQN	FS		R	AS2776	87							RL					
226	September Lake	067	25	4	83I	WQN	FS	RL	R	AS2776	90												
227	Francis Lake	066	25	4	83I	WBA			R	AS2776	62							RL			FSA	FCF	
230	Pembina River	066	02	5	83J	FSA	LDV	WUH	R	AS2527	243	VDV			WMC			RR					
231	Quitting Lake	088	03	5	84B	WWN	RL		R	AS3059	203-204												
232	Round Lake	089	04	5	84B	FSA	FCF	WWN	R	AS3060	68							RL					
299	Snipe Creek OGF	095	17	4	84H	VOG			R	AS3146	279-181												
319	Gregoire Beach Ridge	087	08	4	74D	LFB	WDV	VDV	R	AS3058	236-238												
321	Christina Slumps	087	06	4	74D	LSS	LDV	VDV	R	AS3059	120												
328	Ells River OGF	096	11	4	74E	VOG			R	AS3051	79-80												

NBR	NAME	TWP	RG	M	NTS	KFC	KFC	KFC	S	FLTLIN	PHOTNUM	VEG	VEG	VEG	WLD	WLD	WLD	LDF	LDF	LDF	FSH	FSH	FS
371	Trout River Delta	084	04	5	84B	LDV	WDV	VDV	P	AS3057	195-200	VSP			WML	WWN	WFH	LGE	LED	LGH			
389	Fawcett Diversity Area	064	02	5	83J	WDV	VRS	LDV	R	AS2527	120-123	VDV	VSP		WHN			LED	RL	PBP			
391	Salteaux River Diversity Area	068	02	5	83J	LED	LDV	WDV	R	AS2528	110-115	VDV	VRS					RL					
392	Chisholm Dune Field	069	01	5	83J	LED	VDV		R	AS2528	170-172												
393	North Wabasca Springs/Seeps	081	25	4	84A	RSP	RSE	VDV	R	AS3056	79	VPC			WML								
401	Landels River	078	01	4	73M	WMC	WFH	FSA	R	AS2791	312							RR					
423	Joslyn Creek OGF	096	11	4	74E	VOG			R	AS3051	53-54												
458	Iron Point Caribou Area	075	18	4	83P	WCH	PFC		P	AS2791	51-53												
464	House River (Upper)	079	13	4	73M	FSA	RR	LFM	R	AS2770	130	VDV			WMC	WFH		LDV					
487	Athabasca River-Pembina Reach	070	23	4	83P	FSA	WMH	LDV	N			VDV						RR			FSM		
489	Lesser Slave River	071	01	5	83O	FSA	WMH	WMC	R	AS2790	25							RR					
490	Meyer Lake/Chain Lakes	069	24	4	83I	FSA	WWN	WHN	R	AS2776	144							RL			FCF		
493	Hubert Lake	064	02	5	83J	WHN			R									RL					
497	Fort Hills	097	09	4	74E	LGK	LDV	WMH	R	AS3051	107-111	VDV			WFH								
500	Birch Mountains Diversity Area	099	15	4	84H	LDV	VDV	WDV	P						WCH	WFH		RL	RR	RC	FSA	FTL	
505	Salteaux River	071	03	5	83O	FSA	WMH	LDV	R			VDV			WFH			RR					
518	Landels River Diversity Area	077	02	4	73M	LDV	VDV	WDV	R	AS2791	231-233							RC	RL	LFM			
519	Broken Springs	089	05	4	74D	RSP	WML		R	AS3060	119												
524	McClelland Lake	098	09	4	74E	RL	WWS	WBN	R	AS3051	134-136												
525	Pelican River	078	20	4	83P	RR	LDV		R	AS2791	280-283	VDV			WMH			LFM					
526	Pelican Mountains Escarpment	077	22	4	83P	WMH	LSE	LDV	R			VDV											
527	Parallel Creek Peatland	076	19	4	83P	WCH	PFC	LDV	P			VDV						PBP	RL	RC			
529	McMillan Lake Moose Area	074	18	4	83P	WMH	LDV	VDV	R	AS2790	269												
531	Athabasca River-Rapids Reach	087	17	4	83P	FSA	LFR	WMH	N			VDV			WFH	WRH		RR	LDV		FSM		
532	Athabasca River-Tar Sand Reach	095	11	4	74E	FSA	RR	WMH	N			VDV			WWS			LDV			FSM		
533	La Biche River	070	18	4	83P	FSA	RR		R	AS2776	208												
534	Wabasca River (Canyon)	093	04	5	84G	FSA	LDV	WMH	P	AS3146	65-66							RR	LSS	LRL			
535	Chipewyan Diversity Area	090	21	4	84A	LDV	VDV	WDV	R	AS3060	215-219							RC	LFM	RL			
538	Horse River Diversity Area	088	14	4	84A	LED	VDV	LDV	R	AS3059	226-227				WFH	WDV		RL	PBP				
539	Algar Lake Peatland	082	15	4	84A	PFD	LDV	RSP	R	AS3056	230-235	VDV			WCH			LFB	RC				
540	Hospital Creek Diversity Area	087	02	5	84B	LDV	VDV	WDV	R	AS3059	70-75							RL	RC	LGE			
541	Equisetum Lake	089	05	5	84B	FSA	FCF	WWN	R	AS3060	66							RL					
543	Hunt Creek Diversity Area	093	05	5	84G	RSP	LDV	VDV	R	AS3146	64-65							RL					
544	Panny Tower Diversity Area	094	04	5	84G	RL	LDV	VDV	R	AS3146	158-159							RC					
545	Gordon Lake Diversity Area	086	03	4	74D	LDV	VDV	WDV	R	AS3058	245-246				WFH	WWA	WBS	RL	PBP		FSA		
546	Garson Lake	084	01	4	74D	FSA	RSP	RL	R	AS3057	257-258										FCF		
547	Watchusk Lake Diversity Area	083	02	4	74D	WDV	RL	RC	R	AS3057	125-128	VDV			WMH	WFH		LDV	LFM		FSA		
550	Thickwood Hills	090	12	4	74D	LDV	VDV	WDV	R	AS3060	232-234				WFH	WCH		LGH	PBP				
551	Tar River	096	11	4	74E	RR	LFM		R	AS3051	78-79				WMH						FSR		
552	Calumet River	097	11	4	74E	RL	WOH	WMC	R	AS3051	104-106							RR			FS		
554	Birch Mountains Escarpment	096	15	4	84H	LGF	VDV	LSE	R	AS3051	129-130				WFH	WMH							
555	Calumet Plains	098	11	4	74E	WMH	LDV	VDV	R	AS3051	77-78				WFH								
556	Clearwater Lake Diversity	095	17	4	84H	LDV	VDV	WDV	R	AS3146	279-281				WPF	WDN							
557	Big Island Lake	099	16	4	84H	WPN	WQN	FSA	P	AS3148	98-99				WBN			RL					
561	Square Lake	068	12	4	73L	FSA	FCF	WWS	R	AS2525	45							RL					
562	Unnamed (Twin) Lake	070	13	4	73M	FSA	RL		R	AS2776	217												
563	Unnamed (Mile 18) Lake	071	13	4	73M	FS	RL		R	AS2790	51												
564	Edwards Lake	075	09	4	73M	FSA	FCF	RL	R	AS2791	69												
565	Unnamed (Kimowin) Lake	083	01	4	74D	FSA	RL		R	AS3057	127-128												

NBR	NAME	TWP	RG	M	NTS	KFC	KFC	KFC	S	FLTLIN	PHOTNUM	VEG	VEG	VEG	WLD	WLD	WLD	LDF	LDF	LDF	FSH	FSH	FSH
566	Unnamed Lake	100	15	4	84H	FSA	RL		R	AS3148	199							RC	RL				
569	Trout Mountain Moose Area	089	02	5	84B	WMH			R	AS3060	71-72	VOG											
570	Touchwood Lake	067	10	4	73L	FSA	FCF	RL	P	AS2525	16-17												
571	Jackson Lake	067	11	4	73L	FSA	FCF	RL	R	AS2525	12-14												
572	Kinnaird Lake	067	10	4	73L	FSA	FCF	RL	R	AS2524	166												
573	Akuinu River	067	03	5	83J	RR	WFH	WMC	R														
575	Mistehae Lake	080	02	5	83O	FSA	FCF	WWA	R	AS2770	176												
577	McGuffin Lake	067	11	4	73L	FSA	FCF	RL	R	AS2525	12												
578	Spencer Lake	067	09	4	73L	FSA	FCF	RL	R	AS2525	18-20				WQN								
579	Seibert Lake	067	09	4	73L	FSA	FTL	FCF	P	AS2524	170-172												
580	Glover Lake	075	09	4	73M	FSA	FCF	RL	R	AS2791	68												
581	Jumbo Lake	073	04	4	73M	FSA	FCF	RL	R	AS2790	218-219												
582	Driftwood Lake	085	02	5	84B	FSA	FCF	RL	R	AS3058	76				WWN								
583	Long Lake	090	02	5	84B	FSA	FCF	RL	R	AS3060	206-207												
584	West Twin Lake	090	04	5	84B	FSA	FCF	RL	R	AS3060	203												
585	Horseshoe Lake	065	02	5	83J	WWA	FS	RL	R	AS2527	181-182										FCF		
586	Gods Lake	090	02	5	84B	FSA	FTL	RL	P	AS3060	205				WWN								
587	Brintnell Lake	078	05	5	83O	FSA	FCF	RL	R	AS2791	260												
589	Unnamed (Hebephrenic) Lake	090	02	5	84B	FSA	FCF	RL	R	AS3060	206												
590	Royemma Lake	075	01	4	73M	FSA	FCF	RL	R	AS2591	81												
591	Unnamed Lake	080	03	4	73M	FSA	RL		R	AS2770	228-229				WPN	WBN	WWS	RL	RR	RC			
592	Namur/Gardiner Watershed				84H	FSA	FCF	FTL	P	AS3147	280-288				WOH	WDV	WXN	RL	RR	PBP	FCF		
593	Winefred/Grist Watershed				73M	FSA	FTL	WFH	P	AS2790	290-298				WMH	WWA		RL	RR	RC			
594	Peerless/Graham Lake Watershed				84B	FSA	FCF	WDV	P	AS3059	198-203												
595	Unnamed (Sand) River	074	04	4	73M	FSA	WOH	RC	R	AS2790	290-298												
598	Piche River	070	11	4	73M	FSA	RR		R	AS2525	95-99												
603	McClelland Lake Sinkholes	098	09	4	74E	LRK	RL		P	AS3051	135				WCH	WFH		PBT	PFP	RL			
604	Surmont Diversity Area	084	08	4	74D	LDV	VDV	WDV	R	AS3057	245												
605	Birch Mountain Caribou Area	098	15	4	84H	WCH	WFH		R	AS3146	270-271												
606	Firebag Marten Area	100	07	4	74E	WFH			R	AS3051	190-191												
607	Wiau Caribou Area	074	10	4	73M	WCH			P	AS2790	282-285												
608	Christina Lake Caribou Area	077	05	4	73M	WCH	WFH		P	AS2791	225-229	VDV											
609	Dover-McKay Moose Area	093	13	4	74E	WMH			R	AS3051	2-3												
610	September Lake Moose Area	067	26	4	83I	WMH			R	AS2776	88-89												
611	Nipisi Lake Caribou Area	079	07	5	83O	WCH			P	AS2770	95-96												
612	Salteaux River Caribou Area	069	02	5	83J	WCH			P	AS2528	167-169				WDV	WMO							
613	Calumet Old Growth Forest	097	10	4	74E	VOG			R	AS3051	106-107												
614	Touchwood Old Growth Forest	067	09	4	73L	VOG			R	AS2525	17												

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    ADDITIONAL COMMENTS

001 Includes Ecological Reserve
002 Pair of large sinkholes in TWP 98 RG 10 and 1 sinkhole in TWP 98 RG 11
003 Sandhill cranes and Canada goose nesting
004 Large travertine cone and mineralized springs flowing into ox-bow lake
005 Saline spring on Devonian limestone
006 Falls springs rapids marshes and bedrock stacks
007 Outstanding sportfishery includes lake trout
008 Caribou habitat diverse peatland wetland vegetation community
009 Numerous lakes and terrain features
010 Headwaters of the Panny River
011 Sand plain fens peat plateaus riparian areas upland forests lakes
012 Proposed provincial park and recreation area outstanding fishery
013 Located in old Athabasca River channel old spruce and balsam poplar
015
016
017 Outstanding sportfishery source location for walleye spawn
018 Outstanding sportfishery incised ox-bows major wildlife corridor
019 Floodplain lake
020
021 Southwest extent of dunes formed by easterly winds
022 Includes proposed natural area discharge fen
023
024 Salt springs crescentic pool fluvial fans and aprons
026 Provincially significant staging area for waterfowl
028 Very large diverse peatland headwaters of Christina River
029 Drains Watchusk Formby and associated lakes walleye spawning at mouth
030 Key moose habitat sand dunes lakes and peatlands
031 Firebag and tributaries provincially significant grayling habitat
032
033 Old growth jackpine forest (185 years old 110.3 ha)
034
035
036 Rare orchid site on north end of lake
037
038 Key moose wintering at Birch Mountain escarpment grayling spawning
039
040
042 Old growth alluvial white spruce forest (175 years old)
043 Grayling spawning area
045 Northern pike and burbot spawning over 20 fish species recorded
046 Old growth white spruce alluvial forest (215 years old 102 ha)
049 Northeastern-most range of mountain whitefish deeply incised scenic
052
053 Black spruce forest west of Mink Lake (195 years old 33 ha)
057
060 Large seepage area and diverse wetland habitat on north side of lake
062
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	ADDITIONAL COMMENTS
065	Provincial park on north end of lake
067	
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079	High avian diversity possible sandhill crane nesting fire 1990 W. side
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081	
082	Important river otter habitat
083	Part of large diversity area
084	Old-growth black spruce forest (175 years old)
088	
089	
090	Provincially significant trophy lake with fishing lodges
091	
093	Classic example of a meltwater channel exc. moose habitat scenic river
096	
098	
101	Exceptionally important waterfowl breeding and staging area
104	
113	Deeply incised meanders scenic river important wildlife area
115	
118	Deeply incised meanders
120	Important grayling and pike habitat
124	Old-growth black spruce (205-255 years old) boreal foothills outlier
125	Eastern outlier of the Boreal Foothills Ecoregion
127	Diverse upland/wetland area numerous lakes
128	Provincially significant nesting area - pelicans cormorants and herons
129	Important for the maintenance of sport and commerical fishery
132	
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138	Part of a hydrologcially important lake complex
139	Part of a hydrologically important lake complex
140	Part of a hydrologically important lake complex
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	ADDITIONAL COMMENTS
158	Important walleye spawning and moose over-wintering area
159	
162	Old-growth black spruce forest (195 years old 33 ha) on west side
163	
165	
169	
175	Old-growth upland white spruce forest (165-175 years old 215 ha)
176	
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180	
182	
183	
184	Important lake trout fishery
185	Very good walleye and pike sport and commercial fishery
186	Old-growth alluvial white spruce (170-190 years old 623 ha)
187	
191	
195	
197	Old-growth upland white and black spruce forest (155 years old 504 ha)
198	
201	Walleye spawning
202	
203	
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205	
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210	
211	Contains 6 species of sportfish spawning for pike cisco and whitefish
212	
213	Contains 6 species of sportfish
214	
216	Some of the highest quality year-round moose habitat in the region
217	Diverse and productive riparian habitat interesting meander features
218	One of the last undisturbed sport fisheries in the region
219	
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299	Old-growth white spruce forest (165 years old 595 ha)
319	Best example of post-glacial lake beach ridge in area
321	
328	Old-growth alluvial white spruce/balsam poplar (170 years old 113 ha)

	ADDITIONAL COMMENTS
371	
389	Contains pitcher plants and rare orchids
391	
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401	Major tributory of Winefred Lake
423	Old-growth jackpine forest (150 years old 157 ha)
458	Key caribou habitat
464	
487	Part of a nationally significant watercourse
489	Outstanding fish diversity northern pike spawning
490	Important sport fishery for pike perch and trout
493	Contains a sizeable heronry (approximately 50 nests)
497	Good example of a dissected kame supporting a diversty of habitats
500	Large plateau supporting boreal sub-arctic and foothills species
505	
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524	Large shallow lake moderately important waterfowl staging area
525	
526	Exceptionally good year-round moose habitat
527	
529	
531	Scenic river many rapids and bedrock outcrops lake whitefish spawning
532	Important waterfowl staging area interesting bitumen exposures
533	
534	Deeply incised scenic river bedrock outcrops diverse riparian vegetation
535	Many interconnected lakes productive and diverse habitats
538	Diverse combination of sand dunes peatlands and small wetlands
539	
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545	Many significant lakes for waterfowl interesting landform features
546	
547	Upland and wetland habitats productive for waterfowl and furbearers
550	
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552	
554	One of the best examples of glacial flutings in western Canada
555	
556	Exceptionally rich area for wetland wildlife species
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562	Stocked rainbow trout fishery
563	Stocked rainbow trout fishery
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	ADDITIONAL COMMENTS
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585	Stocked rainbow trout fishery
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592	Outstanding for sportfish production pelicans and eagles
593	Outstanding for sportfish production otters cormorants herons eagles
594	Outstanding sport and commercial fish production
595	Walleye spawning habitat
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603	String of 12 karst lakes in mixedwood forest
604	Diverse area of upland escarpment peatlands and numerous lakes
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609	Diversity of upland and wetland riparian habitat exceptional for moose
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613	Old growth balsam poplar stand (175 years old) on fluvial terraces
614	Old growth white spruce/balsam fir forest (120-170 years old)

MAPS

MAPS
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CARTES
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